February 8, 1923

Engineering News-Record

Devoted to Civil Engineering and Contracting.

McGraw-Hill Company, Inc.

Well-drilling bit used in sinking 250-ft. piles for Hudson River Vehicle Tunnel

Drive 250-ft. Piles for Hudson River Tunnel Shaft—From Job and Office: Hints That Cut Costs and Time—Sewage Purification in Europe: Status of the Older Types of Treatment: by George W. Fuller—The Meeting of the Associated General Contractors at Los Angeles

Ford Motor Company, J. J. Storage Building, Detroit, Michigan, covered with 213,000 square feet of Federal Cement Tile and flooded with daylight through the use of over 4,000 Glass Tile.

Will your next roof cost be your last roof cost?

IF YOUR roofs need replacing remember, that fact is, in itself, an irrefutable argument for Federal Cement Tile—"The Roof for Permanence."

You can replace your short-lived roof with inexpensive material—but if you do, the job isn't finished and your roofing cost isn't ended.

A *permanent* roof of precast stone-concrete, scientifically made, properly laid, and unconditionally guaranteed by the largest exclusive manufacturer of fireproof roofing in the world, represents your *final* roof cost.

Such a roof is—

FEDERAL Cement Tile

"The Roof for Permanence"

Made, laid and guaranteed by Federal Cement Tile Co., 110 S. Dearborn St., Chicago
Works: Hammond, Ind., and Detroit, Mich.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 90 — NEW YORK, FEBRUARY 8, 1923 — Number 6

An Engineer Needed

LAST month the mayor of New York appointed to a commission "to survey traffic conditions and recommend methods for relieving congestion in the streets" a police magistrate, the commissioner of police, the license commissioner, a health department official and the corporation counsel. Have the engineers of the city no way of impressing upon the mayor that traffic is a problem on which the engineer might reasonably be expected to know as much at least as a lawyer, a policeman or a doctor?

For Better Building

A MINIMUM specification for the structural part of dwelling houses, prepared by an expert committee for the Department of Commerce and just published, contributes in a new way to the art of building. Its chief merit lies not in giving new facts or showing new methods of building, but in bringing together for the first time and making available for the information of the widest circles the essential elements of sound design of dwelling houses. It is certain to have the effect of raising the standard of building in this field; and the dwelling house, it must be remembered, absorbs nearly one-third of the total expenditures for building. Whether the specification carries out the original purpose of the committee's appointment, to promote economy in building by saving material and labor and by eliminating variation in building is not so obvious. It appears that the only direct economy brought about is the reduction of minimum wall thicknesses to 8 in. (brick) and 6 in. (concrete), and the approval of hollow brick walls, while in other provisions, notably those for firestopping, the new rules call for increased expenditure by requiring better construction—obtained through rather simple means. However, a large indirect saving should result, through the elimination of poor construction, with its attendant evils of quick deterioration, frequent repairs, and large ratio of fire loss.

A Minimum Code

WISELY the committee which formulated the new rules has given them the title of "Minimum Requirements." In emphasizing the "minimum" the committee has done a service to sound building administration which extends beyond the specific field covered. No set of rules of the kind can be an automatic and complete guarantee of safety, and even the most ample requirements would still contain the possibility of bad results. Rules for general application can, therefore, only set a minimum standard. This means that no one should go below but many should exceed the limit fixed, by building more strongly and more amply than the minimum. Present building practice under detailed building-code specifications largely ignores this viewpoint and looks upon code requirements as statements of good practice. May the new rules help to correct this faulty view.

Development of House Construction

ASIDE FROM the direct purpose of the report mentioned, its close relation to the trend of development in house construction is significant—perhaps more so than its economies or its instructional value. For a number of years there has been active study throughout the country to develop new forms of construction, superior to standard frame-house practice and yet able to compete with it in cost. A dozen years ago monolithic poured concrete construction was heralded as the coming development in this direction. More recently, light steel framing covered with incombustible wall and floor surfacing has been the object of interest. Progress hitherto has been disconcertingly slow, but more rapid future progress is to be looked for. The establishment of a thoroughly studied minimum standard of house building under present methods of practice should tend to guide this progress along safe lines and, in addition, to stimulate effort to perfect new types.

The Passing of Chemical Precipitation

SEWAGE treatment by chemical precipitation, extensively used for many years in England, is classed as a thing of the past by George W. Fuller in the second of his Impressions, elsewhere in this issue. The process never gained the foothold in America that it did in England. For two decades it has rarely been adopted in either country for new works or extensions. The passing of chemical precipitation is due to the fact that it increases while the newer processes decrease the volume of sludge to be got rid of—and sludge remains, as was so well expressed long ago, the crux of the sewage problem. It was the septic tank and contact bed, the latter soon followed by the sprinkling or percolating filter, that threw chemical precipitation and some other methods into the discard. Mr. Fuller's conclusion is that the septic tank is also becoming a thing of the past in England. It should be noted that almost all the septic tanks in England are of the one-story or Cameron type, the two-story Travis tank never getting beyond Hampton, Norwich and perhaps one or two other places, while the Imhoff adaptation did not gain even that much ground on English soil, although well established in both the United States and Canada before the European War. Imhoff tanks are still widely used in North America, and constantly being recommended for new installations by many engineers. Whether England would have turned so far away from the septic tank as Mr. Fuller indicates had two-story tanks come in use as extensively there as here is an interesting question that cannot be discussed now. The fact is, however, that the Imhoff tank at its best, like other methods of sewage treatment, presents a sludge problem—a problem that will doubtless exist in some degree as long as cities exist. The hope of the future is the activated-sludge process, but it still presents many problems for solution, as Mr. Fuller's concluding article will show.

Original Foundation Work

THE solution of an unusual and difficult foundation problem in connection with the construction of the Hudson River vehicle tunnel, as described in this issue, contains some striking elements of interest. First of these is the resourcefulness and thoroughness with which the manifold details of construction were worked out in the field. The essence of the undertaking was the plumb driving of the 24-in. pipes that form the casings for the piles. Carefully plumbing the first sections of each pile and drilling a hole ahead of each section of pipe solved this problem. Success in detail still depended on the plumbing devices, the tools for placing reinforcement and concrete, and the internal pipe cutter, all of which were worked out with praiseworthy ingenuity. The whole undertaking, moreover, represents a bold and original attack on an exceedingly difficult problem—that of sinking large piles through soft bottom to rock at a depth of 250 ft. Its successful accomplishment is an important contribution to the foundation art. It is possible that the methods used will have only limited future application. Disregarding cost, as a secondary consideration, it is necessary that the material to be penetrated shall be sufficiently stable to permit the drilling of the hole in advance of the casing, and, in the case of long piles, sufficiently stable also to give them the necessary lateral support. But subject to the limiting considerations in each particular case, it has been demonstrated that well-drilling methods can be used to put down a steel casing through soft soil, substantially plumb, to depths usually considered far beyond reach, and thereby to develop a firm foundation.

The Railroads Tackle the Port Problem

THE collective action of the trunk-line railroads that enter New York in retaining engineering counsel to undertake a study of the railroad transportation problem of that port is encouraging, although considerably handicapped from the start. It is to be regretted that the roads could not see their way clear to begin this study a year ago when the plan of the Port Authority was finally legalized, and when it was evident that sooner or later they would be required to define their position toward it and to indicate how far they would be willing to go in co-operating to solve the port terminal problem. If they had done this, they now would be in position to offer a positive and constructive contribution, backed by their united influence, instead of finding themselves once more in the rôle of "stand-pat" objector, to all appearances bent only on opposition to what someone else has proposed. But it is inconceivable that at this juncture the roads should fail to seize the opportunity to disclaim a dog-in-the-manger policy. Unfortunately, it is quite possible that the first phase of the investigation must be directed toward opposing the Port Authority plan before the Interstate Commerce Commission, but even here it seems possible to lay a foundation that will offer unmistakable evidence of a worthwhile structure to follow. Through their several spokesmen, the railroads just now are making a strong bid for public favor to sustain them through what promises to be a year of legislative storm and stress. But actions speak louder than words, and it is quite possible that the executives of the trunk lines entering New York have an opportunity to forward the campaign in defense of the railroad managements.

Voting on the Federation

IN ACCORDANCE with the decision of the Board of Direction, reached just before the annual meeting of the society, the American Society of Civil Engineers is to hold another referendum on the question of its affiliation with the Federated American Engineering Societies. The former ballot on this proposal, canvassed in November, 1920, was taken under conditions quite different from those that now prevail. Then the federation had just been organized and consisted of little more than an idea and a hope; today it has been in existence for two years and has written a record by which it may be judged. If, two years ago, the civil engineers rejected the federation on the strength of their estimate as to future developments, today they can act in the light of experience.

When the federation was organized, this journal, together with substantially all the other elements that composed the engineering life of the nation, bespoke for it the interest and support of engineers in every field, anxious lest there be lost an opportunity to try out a great experiment that offered promise of far-reaching benefit to the profession. We believed that good might be achieved through a closer co-operation between the various branches of the profession and through the creation of an agency that would voice worthily its significance in the life of the nation. At that time this idea was so new to the great body of the profession that we felt it incumbent upon us to aid in its spread. Today the idea is familiar to all.

In what degree the federation, as constituted, has risen to its responsibility—to what extent it has fulfilled the hopes of the great body of the profession that sponsored it—is now a matter of record. This does not mean that it would be fair to accept the record of two years as marking the ultimate achievement of the federation, but it does mean that in that record will be found a fair indication as to whether the machinery of the federation has been soundly contrived and efficiently operated, as to whether it is on the right track and making progress—in short, as to whether the existing organization is the answer to the need for which it was created. Opinions may differ as to the significance of that record; but it is there, to be read and interpreted according to the vision and the penetration of all who may be interested.

The issue is now before the members of the American Society of Civil Engineers, to be decided according to their individual judgments in the light of the facts before them. Under these conditions we feel no obligation to the profession comparable with that which impelled us to advocate the organization of the federation. Then the question was one of stimulating within the ranks of a profession a desire to translate a new and abstract idea into concrete reality; today the question is whether one society in that profession, which elected to bide its time and watch, shall decide to affiliate with an established enterprise of two years standing.

The issue, to be sure, is of vital concern to the members of the American Society of Civil Engineers, and the decision is in their hands—where it belongs. The influence and the resources of the society are in their keeping, to be applied as they think best toward forwarding the objects set forth in its constitution. The arguments pro and con, interpreting the record of the federation and setting forth its significance to their society, will be presented to them by committees of their

own Board of Direction, familiar with its affairs and its interests. In the light of those arguments, supplemented wherever possible by individual knowledge and conviction on the subject, the membership-at-large will formulate the decision of the society.

Garbage Disposal and the Daily Press

TECHNICAL misinformation circulated by the daily press is voluminous and varied but no field is so persistently misinterpreted as that of garbage disposal. The latest flagrant example comes from the editorial pages of the Montreal *Star*, which is pleading for the substitution of incinerators for dumps. The editor says:

> The outrageous custom has been in vogue here for years of dumping garbage in open places, to the detriment of health, and also to serious monetary loss.
>
> Ever since Montreal has been a city it has made no satisfactory move to utilize its garbage for power-producing purposes. In well-managed European cities it is usual to make garbage plants pay very much over their cost of construction and maintenance.
>
> An expert on garbage destruction in this city is authority for the statement than an up-to-date method of burning the garbage would result in the corporation [city] reaping an annual revenue of over $100,000.
>
> Open-air dumps have been prime factors in the spreading of infectious diseases. Surely the horror of such dumps will not be tolerated much longer.

Who is this "expert" who says that Montreal could reap $100,000 annually from incinerators; which are the "European cities in which it is usual to make garbage plants pay very much over their cost of construction and maintenance"; what "infectious diseases" have been spread by or from garbage dumps in Montreal?

Such ill founded assertions in the daily press and by members of civic associations are largely responsible for the abandoned garbage disposal plants of various kinds scattered over the continent. These assertions sometimes help get large appropriations for garbage works which when built put a heavy burden on the municipal treasury, as should have been known and frankly stated as inevitable. After a time, money for maintenance and operation, or even for intelligent supervision, is not appropriated; nuisances arise that may be far worse than a well managed dump; and finally the plant is shut down.

A few well directed inquiries would show the Montreal *Star* and other daily papers with too much zeal and little or no reliable information, that garbage disposal at best can only produce a revenue that will help reduce the cost of collection and disposal; that in its very home in England the refuse destructor has never attained the fullness of use nor produced the amount of heat revenue commonly claimed for it; that today British cities are turning from destructors to other means of mixed refuse disposal; that the British Ministry of Health sanctions refuse dumping, if the refuse be covered according to prescribed rules; that it is the abuse and not the use of refuse dumping that is objectionable; that well regulated dumps, when sites can be found within reasonable hauling distance, may be less costly than incineration or any other method of disposal commonly feasible, and finally that there is no proof that infectious diseases are spread from open-air dumps.

It would seem unfair to dismiss this subject without a word of—perhaps excuse is as good a term as any—for the daily press. The multiplicity of the subjects with which it is expected if not forced to deal lays it open to a thousand chances to error. The technical press, with its staff of trained specialists, has difficulties enough in avoiding error. How, then, expect immunity from errors in the daily press which cannot possibly have specialists in more than a few fields? The answer to this is a question for the daily press itself, except that it must resort more often to experts as consultants; be sure that those it consults know their fields and have no axes to grind; use a large amount of plain, commonsense; and last but not least shun sensationalism and partisanship—at least when dealing with technical matters.

A Promise of Increasing Usefulness

IN ITS five short years of existence the Associated General Contractors has developed into a most virile and effective organization. Last week's convention in Los Angeles showed that its energies are not likely to abate even though the budget for the coming year will require some restriction of breadth of activity. There was the same clear appreciation of the external factors that handicap the efficient execution of constructive work, the same vigorous determination to take steps to remove them, and a heightened interest, as shown by the report of the committee on methods and the subsequent discussion, in the measures needed to increase the internal effectiveness of contracting organizations. The outlook for future usefulness is excellent.

To date the chief efforts of the association have been directed outwardly. It has been a center of energizing thought in the construction industry. The development of an equitable form of standard contract, the move to secure the correction of highway construction practice hampering to the contractor and not advantageous to the public, the agitation for reform in surety practice, the stimulation of standardization effort among equipment manufacturers—these are typical of its efforts to draw into co-operative relations other branches of the industry.

If the report of the committee on methods and its reception by the convention are an index of the trend, there will be equal virility in future in attacking problems within contracting organizations themselves. Much good work has already been done—as instanced by the preparation of standard estimating sheets and of a model form of financial statement, by the studies of depreciation rates and of labor turnover. But the work has hardly been begun. There are broad areas of prospective study of methods of doing work, on cost elements, on management. The technique of construction, so far as possible, needs to be mobilized and to be made generally available. Guesswork would tend to be eliminated with great resulting benefit to contractors and to the public.

Not the least important feature of the convention was the feeling of resentment and regret at the indictment of war construction officials and the suits against the cantonment builders. Nor was the resentment due primarily to the fact that the charges have been brought against friends, but rather to the consequent shaking of public faith in contractors generally. The feeling was but another evidence of the new "pride of calling" which the association in its brief life has developed among the contractors of the country.

With such a "pride of calling" and with a continuance of virile management there is renewed promise of steadily increasing usefulness.

Driving 250-ft. Piles for Hudson River Tunnel Shaft

Footings for Vehicle Tunnel Shafts Consist of 24-in. Pipes Driven 250 ft. to Rock, Filled with Concrete and Cut Off 70 ft. below Bottom of River

This is the first of a series of articles in which Engineering News-Record will, from time to time, describe the progress of the work on the New York-New Jersey vehicle tunnel under the Hudson.—EDITOR.

UNUSUAL methods were invoked to solve the foundation problem that arose in connection with the construction of the river shafts at the New Jersey end of the Hudson River vehicle tunnel now under construction between New York and Jersey City. When the two shaft caissons have been sunk through the Hudson River silt to their intended positions they will come to bearing on a pile footing now under construction. This footing consists of 24-in. steel pipes driven through 30 ft. of water and an average thickness of 220 ft. of soil to ledge rock, then unwatered, filled with concrete reinforced by hooped rods, and cut off at an elevation more than 100 ft. below mean high water and 70 ft. below the bed of the river. No precedents were available for the conduct of this work and substantially all of the methods used were original with the engineers, contractors and sub-contractors responsible for the project.

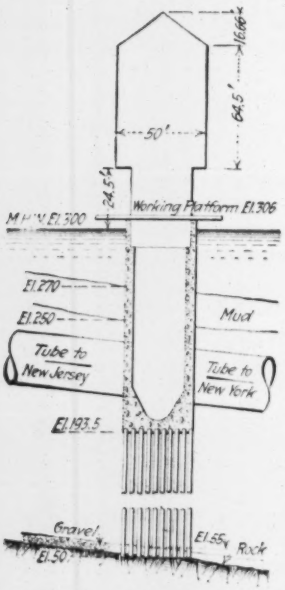


FIG. 2—VENTILATION SHAFT AND FOUNDATION

As was explained in the general description of the Hudson River vehicle tunnel project in *Engineering News-Record* of Feb. 19, 1920, p. 362, the two river shafts, located approximately at the pier-head lines on the New York and New Jersey sides of the river, are important elements in the scheme of ventilation for the tunnel. They play, however, no part in the driving of the tubes, this work being carried on from the land shafts on both sides of the river. The tubes will pass through the river shafts which will have been sunk to position before the shields reach them. The river shaft at the New York side is designed and will be sunk as one unit, through which both tubes will pass; at the New Jersey end there will be two units, one for each tube, built and sunk independently, but connected after they are in place by a cross-passage at the elevation of the tubes.

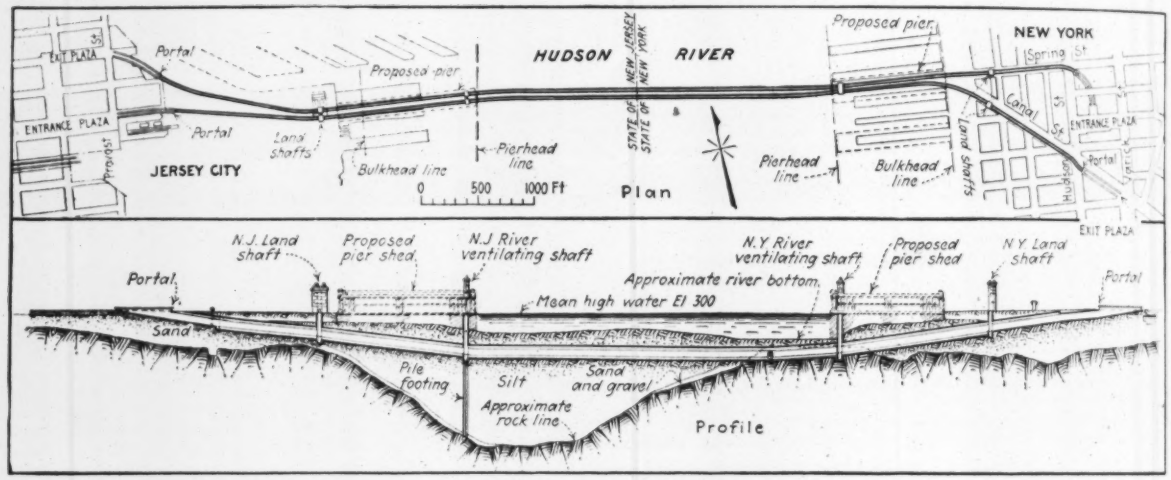


FIG. 1—ALIGNMENT AND PROFILE OF VEHICLE TUNNEL SHOWING PILE FOOTING FOR RIVER SHAFT

As the New Jersey shafts will rest in Hudson River silt at a depth of approximately 106 ft. below mean high water, special study was given to their foundations. As a result of this study there is being installed a pile foundation of unusual design and construction that will provide for the direct transmission of the ventilating-shaft load to the underlying rock more than 150 ft. below its base. Work on this foundation for the north caisson is now substantially completed and the experience that has been obtained upon it will be available in the construction of that for the south caisson, which will be undertaken in the spring.

Foundation Conditions—Each of the two river shafts is 37 ft. 3 in. by 50 ft. 3 in. in plan. The caisson section of the shaft is 108 ft. 6⅜ in. high which brings its rim 2 ft. 1½ in. above mean high water. This, as shown in Fig. 2, is assumed as El. 300. The weight of each shaft, including the superstructure, fans, and other equipment, will be 10,155 tons, which will be reduced by a buoyancy of 6,109 tons, leaving a net weight of 4,046 tons to be supported. The unit load, therefore, amounts to 2.16 tons per square foot without considering the effect of wind loads on the exposed superstructure. When this is taken into account and no credit taken for the lateral support given to the shaft by the surrounding soil, the loading along the leeward edge of the bottom is increased over this net dead load by 30 per cent.

At the site of the shaft the river is about 30 ft. deep at mean high water. The bottom consists of 20 ft. of river mud, underlaid by about 195 ft. of Hudson River silt, and under that a 5-ft. bed of sand and gravel, which rests on bed rock close to El. 50. This makes a total depth from mean high water to ledge rock of about 250 ft. The foot of the shaft, therefore, will rest in Hudson River silt at El. 193.5, while the top of the stratum of silt lies at El. 250, or 50 ft. below mean high water. Although it is probable that the silt could bear safely the estimated load, there prevails so much difference of opinion concerning its physical character in place and its probable behavior under load that it was decided to provide direct support for the shaft by extending footings to the rock.

Design—The plan adopted calls for the provision under each caisson of 42 piles or columns of reinforced concrete extending from ledge rock to the bottoms of the shafts. As the entire weight of the structure would be supported on the piles, the load on each pile is estimated as 97 tons without considering wind loads. In the piles farthest from the center line this dead load may be increased by wind load to 126 tons per pile. Each pile consists of a steel pipe 24 in. in outside diameter and having a $\frac{3}{8}$-in. wall, filled with concrete reinforced as shown in Fig. 3. The cross-sectional area of each pile, including the steel shell, is 452 sq.in., of which 9.4 sq.in. is reinforcement. Assuming the ratio

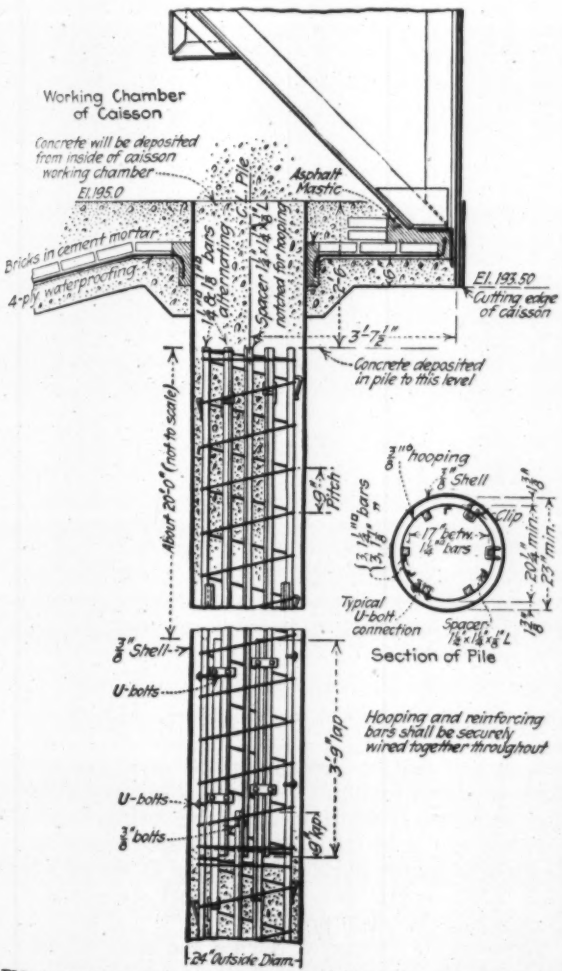


FIG. 3—PILE REINFORCEMENT AND SHAFT CONNECTION

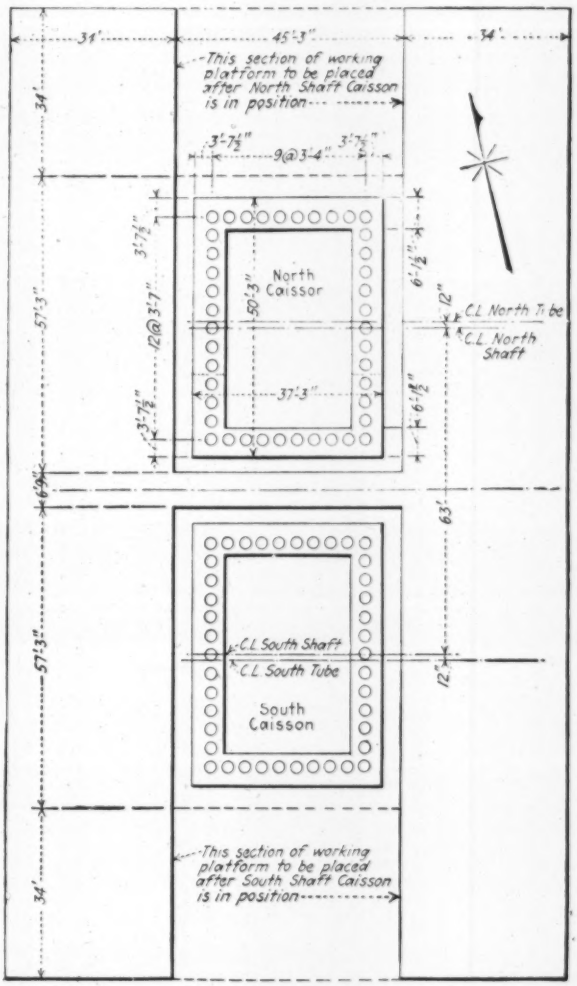


FIG. 4—PLAN OF SHAFTS AND WORKING PLATFORM

of moduli as 15, this is equivalent to 141 sq.in. of concrete, which, added in place of the area of steel, is 584 sq.in. of concrete or equivalent. This, it will be seen, takes no account of the steel shell except to include its cross-section as an equal area of concrete. Under the dead load of 97 tons per pile this gives a unit stress of 333 lb. per sq.in., which, increased by 30 per cent to provide for wind load, makes 432 lb. per sq.in.

The reinforcement consists of six bars, three of which are $1\frac{1}{4}$ in. square and three $1\frac{1}{8}$ in. square placed as shown in Fig. 3, and surrounded by $\frac{3}{8}$-in. round spiral hooping on a 9-in. pitch. This is held in place by three vertical spacers of $1\frac{1}{4}$ x $1\frac{1}{4}$ x $1\frac{1}{8}$-in. angles notched for the hooping. Clips fastened to every bar and spaced 18 in. center to center keep the reinforcement centered in the piles and prevent its coming into contact with the steel shell. Hooping and reinforcing bars were securely wired together throughout, and the reinforcement was assembled in lengths of approximately 20 ft. Each of these lengths or "baskets" was connected to the next one by U-bolts on the square rods, each of which was lapped 3 ft. 9 in. Spacer angles were spliced with $\frac{3}{4}$-in. bolts. Reinforcement and splices are shown in Fig 3..

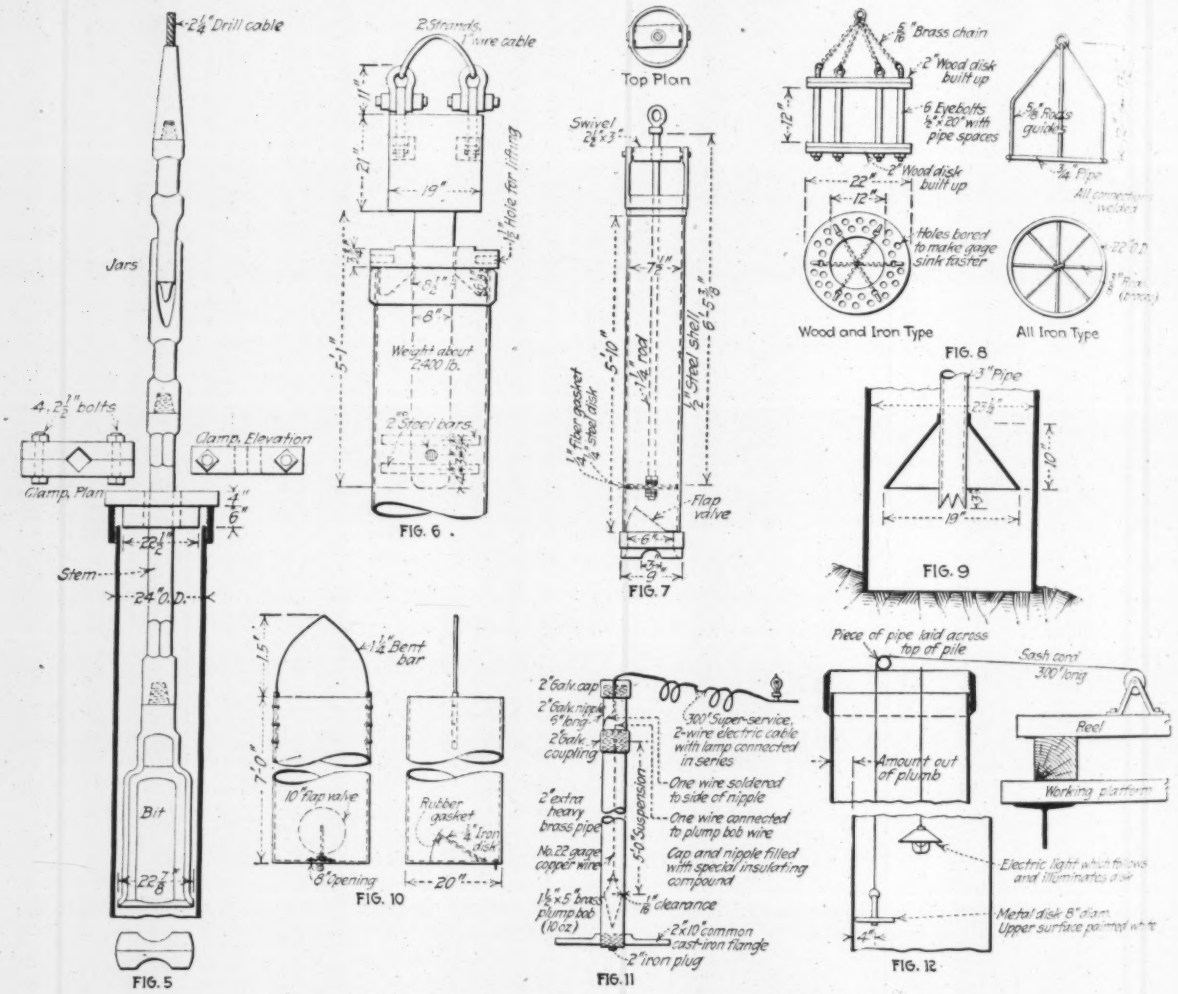
As the l/r ratio of these piles is about 300, they were not expected to act as columns, but a study was made of the resistance that would be offered by the silt to their bending. This indicated that they might safely

be considered on the basis of their cross-sectional area without regard to their characteristics as to columns.

Construction—It will be seen that the installation of these piles involved unusual difficulties and that exceptional methods and special plant would be the rule. The problem involved, for each of the 42 piles, driving a 24-in. pipe through about 30 ft. of water and 220 ft. of bottom to a firm bearing on ledge rock, holding the pipe plumb while driving, placing the reinforcement and cutting it off at an elevation more than 100 ft. below the surface of the river, depositing the concrete up to that same level, and finally cutting off and removing the length of 24-in. pipe above that elevation. In the beginning experiments were made in depositing the concrete in the pipes under water, but results were not satisfactory and it was decided to unwater each pipe. This introduced a new requirement to the problem which not only necessitated the unwatering of the pipe but also made it possible to inspect the interior of each pipe before the reinforcement and concrete were placed. In effect each of these pipes constituted an open caisson rather than a pile in the usual acceptance of the term.

Operations were conducted from a platform built as shown in Fig. 4 at an elevation about 6 ft. above mean high water. In sinking each pipe three 20-ft. lengths of the 24-in. pipe were assembled and held in a vertical position by a derrick. The depth of water being about 30 ft., this brought the top of the second length just above the platform. The projecting 20-ft. length was then plumbed in both directions by the use of transit. Two 12 x 12-in. sticks, suitably notched out, bolted together, and laid horizontally on the deck of the platform as shown in Fig. 18, were used to clamp the pipe and to adjust it while it was being plumbed. When this had been done the sticks were fastened to the deck to serve as guides during the sinking of the pipe. As each 20-ft. length was sunk the next one added was plumbed by the same process.

Experiments conducted during the early stages of the work demonstrated that it would not be practicable



FIGS. 5 TO 12—SPECIAL EQUIPMENT USED IN SINKING 24-IN. PIPES

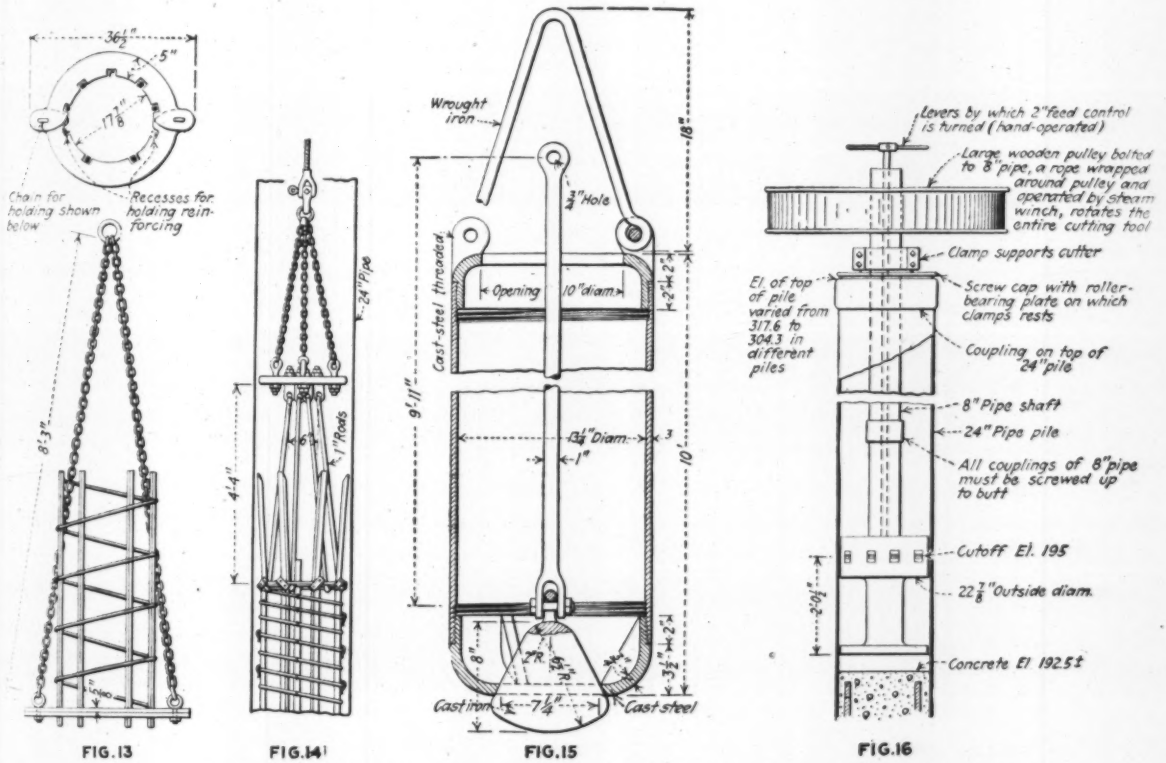
Fig. 5—String of well-drilling tools, showing clamp used.
Fig. 6—Hammer used to drive pipes.
Fig. 7—Bailer used in drilling ahead of pipes.
Fig. 8—Mandrels to test cross-section of pipes. The combination wood and metal type was found to sink too slowly and the all-metal type superseded it.
Fig. 9—Lower end of pipe used to clean out pile by jetting.
Fig. 10—Bailer used to unwater pipes.
Fig. 11—Plumbing device for use in pipe when filled with water.
Fig. 12—Plumbing device for use in pipe which has been unwatered.

to sink the pipes to so great a depth by power driving alone and that it would be exceedingly difficult, if not impossible, to insure their remaining plumb if an ordinary jet were employed. So recourse was had to well-drilling practice, by which the pipe or casing is sunk, length by length, into a hole that has been driven in advance to receive it. The drilling is done by a heavy cutting bit or "spud," which, with its string of accessory tools, is operated through the interior of the pipe already in place, the up-and-down motion being imparted by a machine at the surface operated on the walking-beam principle. As the soil is churned into suspension by this process, the drilling is stopped from time to time and the material raised to the surface in a bailer. A bit with its string of tools is shown in Fig. 5 and a bailer in Fig. 7. Three weights of bits were used on this work; 3,000-lb., 2,500-lb. and 2,000-lb. The 2,500-lb. bit was found to be most satisfactory for general use. Four machines were used on this work as shown in Fig. 17, two of them being No. 27 and two No. 23 Star Portables.

Whenever it becomes necessary to apply power to assist in the sinking of the pipe this usually is done by bolting to the string of tools a heavy steel clamp which is allowed to strike upon a flange or disc over the top of the pipe. The machine then operates as a driver, having a hammer effect equal to the total weight of the bit and tools. Such a clamp is shown in Figs. 5 and 18. In the beginning of this work this practice was followed, but it was found that the danger of accidentally dropping the tools down through the pipe was so imminent that driving was done by withdrawing the drilling tools altogether and using instead the 2,400-lb. hammer, shown in Fig. 6.

As the pipes were lowered it was found that the first three lengths, or 60 ft., would sink of their own weight to the level of the platform. The well-drilling machine then dug 20 ft. below the bottom of the lowest pipe by "spudding and bailing," after which another length of pipe was added at the top and the whole casing lowered 20 ft. The first four sections, 80 ft. of pipe, sank of their own weight in the hole thus prepared. The fifth, sixth, and seventh lengths and sometimes the eighth and ninth went down also without difficulty, sometimes under the weight of a 2,400-lb. hammer and sometimes with the assistance of a light tapping. The tenth section required driving and the eleventh, twelfth, and the thirteenth each went a litle harder, the thirteenth in some cases requiring very hard driving. When fragments of the ledge broken up by the spudding had been brought up in the bailer, the rock was further spudded just sufficiently to insure a level seating for the pipe.

It was found that within a few days after completion of the driving, 50 or 60 ft. of deposit formed at the bottom of each pipe due to settlement of the suspended silt that had been churned up by the spudding process. This deposit was taken out by spudding and bailing again before concreting was commenced. In order not to delay the work by withdrawing one of the four machines that were sinking the pipe a fifth machine of similar design but smaller size was installed to do this secondary cleaning.



FIGS. 13 TO 16—SPECIAL EQUIPMENT USED FOR PLACING REINFORCEMENT AND CONCRETE

Fig. 13—Clamp for handling reinforcement.
Fig. 14—Hooks for lowering assembled reinforcement.
Fig. 15—Bucket for depositing concrete.
Fig. 16—Internal cutter for cutting off piles.

Early in the work it was found that infinite pains were justified in preparing each length of pipe to avoid difficulty in coupling them to each other. The threads were ordered cut with ample clearance and collars having tapered threads were used to prevent damage during transportation and handling. When these collars were removed the threads were cleaned, first with a steam jet and then with a thread comb. If any threads were found to be burred or otherwise imperfect they were dressed by filing. The hammer struck directly on the upper coupling on each length rather than through a driving head screwed into the coupling. This was in accordance with ordinary oil-well drilling practice. After the organization was in good working order each of the four machines used sank one section of 20 ft. in 8 hr. or three lengths in 24 hr. The work was carried on continuously in three shifts.

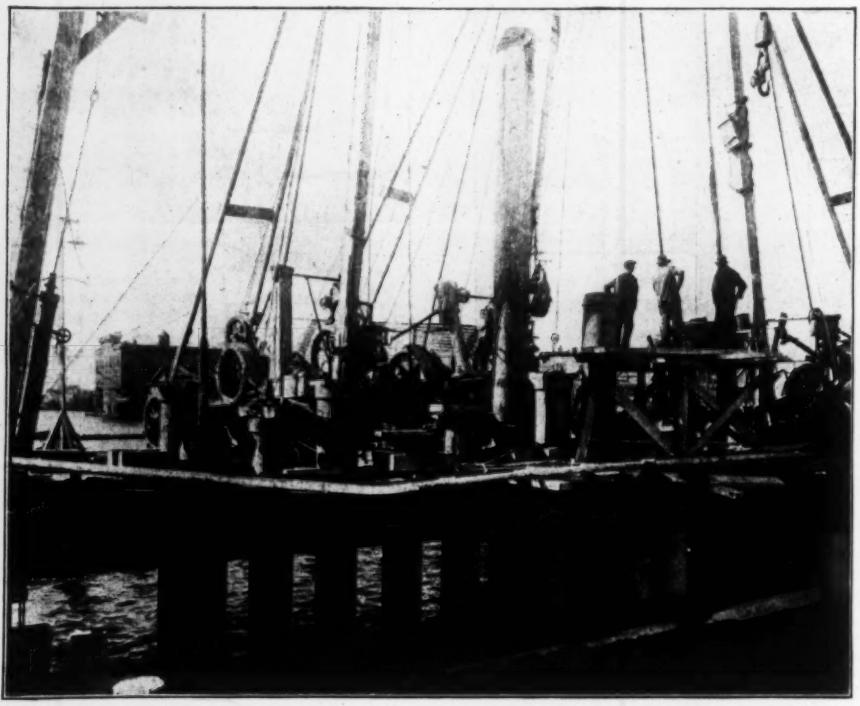


FIG. 17—GENERAL VIEW OF WELL-DRILLING PLANT

Here are shown the four well-drilling machines at work on the first row of piles. To the right of the center a length of pipe has just been added to one pile. Behind it is seen the pulsometer used for jetting the inside of the pipe to clean it. The machine to the left is set for driving a pipe, having a driving clamp fitted to its string of tools. A bailer is shown lashed to the under side of the boom.

After the sediment had been spudded and bailed the pipe was cleaned out by means of a water jet. This jetting was accomplished through a 3-in. wrought-iron pipe fitted at its lower end with an inverted funnel as shown in Fig. 9. Jetting was commenced with the bottom of the pipe about 20 ft. above the rock surface, the pipe then being gradually lowered to within 12 in. of the rock surface. Water pumped down through the 3-in. line by a No. 5 pulsometer pump rose outside of the funnel and was carried away over the top edge of the 24-in. pipe. When the bulk of the suspended matter had thus been carried off the process was reversed and water was pumped into the top of the large pipe by a 2-in. pump and withdrawn through the 3-in. pipe by means of the pulsometer. During this process the 3-in. pipe was lowered slowly until it rested on the rock. This entire cleaning process required from 5 to 6 hr. per pile, the actual pumping time being about 3 hr. After the pulsometer began to discharge clean water the process was continued for about an hour, which was about the time required completely to change the water in a pile. A cage or mandrel was then lowered and raised in each pile to insure freedom from obstruction or deformation of the cross-section.

Concrete Bottom Seal—To unwater the pipes the bottom was first sealed with a plug of special concrete. All concrete was handled into the pile by a special 9-cu.ft. bucket, which is shown in Fig. 15. In forming the plug this bucket was charged first with 4½ cu.ft. of 2 : 3 mortar and 4½ cu.ft. of 1 : 1.6 : 3.2 concrete, which contained 25 per cent more cement than did the 1:2:4 specification concrete. Then followed two buckets of 1:1.6:3.2 concrete, the total of 27 cu.ft. forming the bottom plug. When this had been deposited it was allowed to set for at least ten days after which the water was bailed out by means of a bucket made of a 7-ft. length of 20-in. pipe with a flap valve at the lower end. When the water had been bailed to within 10 ft. of the concrete plug the top of the plug was spudded very lightly to loosen any laitance, which was then removed by bailing the remaining 10 ft. of water. The placing of each plug required about 20 to 30 min. and the bailing of the pile required about 2 hours.

Inspection of Interior of Pipe—Before the reinforcement was placed the interior of the pipe was inspected and tested for plumb driving. This was accomplished by the aid of a white disk, 8 in. in diameter, which was lowered at the end of a sash cord immediately below an electric lamp, the light of which was thrown by a reflector upon the top of the disk. This device, shown diagrammatically in Fig. 12, made it possible to observe the position of the disk all the way down the pipe and to note when it was just touching the pipe wall. Measurement from the upper edge of the pipe to the supporting cord indicated any variation from the vertical. Application of this test at 25-ft. intervals throughout the depth of each pipe showed no substantial variation from the vertical. Only four piles were out of plumb more than 12 in., or one half the diameter of the pipe; and one of these, which was 24 in. out, was the first pile sunk. One was 9½ in. out and one 8½ in., the remainder ranging from nothing to 7 in. off the vertical. This gratifying result is attributed in large measure to the practice of drilling the hole in advance for each 20-ft. length of pipe.

When the work was commenced and it was expected that the pipes would be completed without being unwatered, another device was prepared for this purpose.

This is shown in Fig. 11. It consisted of a 5-ft. length of 2-in. pipe having at its lower end a disk 10 in. in diameter. In the top of this 2-in. pipe was a waterproof plug, from the centre of which was suspended a plumb bob, and through which passed an electric wire connected with the plumb bob. Between this plumb bob and the inside walls of the pipe near its lower end was a clearance of ⅛ in. all around. A wire was then led from the plumb-bob connection and another from the outside wall of the 2-in. pipe. These, together with the line from which the whole arrangement was hung, passed up through the 24-in. pipe to the working platform, where the wires were connected through an electric-light circuit to an electric lamp. It will be seen that so long as this apparatus hangs vertically the circuit will be incomplete, and the lamp will remain dark. If the device be tilted to one side sufficiently to bring the plumb bob in contact with the wall of the pipe the circuit will be completed and the lamp lighted. By this means it was possible to bring the edge of the 10-in.

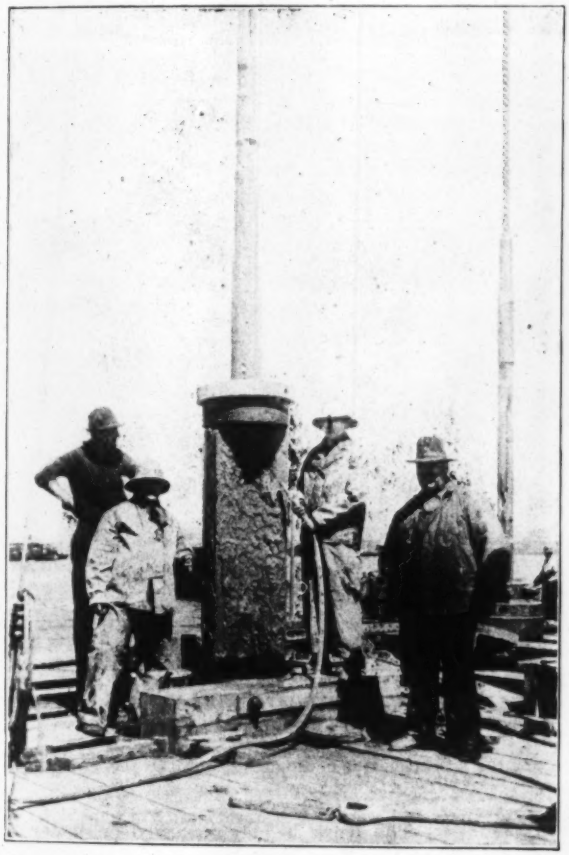


FIG. 18—WELL-DRILLING BIT

The bit has just been withdrawn from a pipe, the top of which may be seen between the notched timbers by which it was plumbed and guided during sinking. Behind the man to the right is seen the upper end of a string of tools in another pipe. The "jars" are just opposite the man's head, and the clamp shown just below his elbow has been fitted to the stem so that the tools may be used as a hammer for driving the pipe in which they hang. Notice that the clamp is absent from the tools that have been "spudding."

disk just touching the side of the pipe and by measuring the distance between the supporting line and the edge of the pipe at its upper end to detect any variation from the vertical. This device was used to plumb each pipe immediately after it was driven.

Placing of Reinforcement—As has been explained, the reinforcement was assembled into units or "baskets," each about 20 ft. long. A special clamp, shown in Fig. 13, was designed to grip each basket near its upper end. By this clamp the basket was lifted to position and held suspended from the top rim of the

FIG. 19—BAILER USED IN DRILLING

After the silt has been churned up below the bottom of the pipe by the bit shown in Fig. 18, the material in suspension is removed through the pipe by means of this bailer. Near the left edge of the picture is seen a string of tools fitted with a driving clamp, while behind the right-hand man hang the tools that have been spudding for the pipe now being bailed. The flange through which the drilling line enters the top of the pipe is shown resting on the upper shoulder of the bit.

pipe, while the derrick swung the next length of basket to be attached. To facilitate this operation the clamp was applied just below the point at which would come the lower end of the splice. As each successive basket was added at the upper end the whole reinforcemnt was lowered, a careful tally being kept of the length that had been let down. The total length of reinforcement required for each particular pile was, of course, known in advance. As the upper end of the reinforcement in each pile must be at the elevation of the cutoff, more than 100 ft. below the level of the platform from which the work was handled, it usually was necessary to cut the upper length to fit, which was done by a blow flame. The reinforcement was lowered to position by means of an attachment shown in Fig. 14. This consisted of a heavy circular steel disk slightly smaller than the inside diameter of the pipe, and having on its top three eye-bolts from which it was suspended to the derrick line. Swinging from its under side were six hooks each about 4 ft. long attached by swivels on a circle of 6-in. diameter. When these hooks were engaged in the lift-

FIG. 20—PORTABLE CONCRETE BIN

ing rings of ⅜-in. wire at the top of the reinforcement their lower ends were spread, as will be seen in the diagram. When the reinforcement had been lowered to position inside the casing and had come to bearing on the bottom the derrick line was slacked off just enough for the hooks to swing vertically into the center, thereby clearing the reinforcement, after which the disk was raised to the surface. The installation of the reinforcement in one pile required about 5 hr.

Depositing Concrete—Concrete was machine mixed on the working platform and was handled by derrick to a portable elevated bin or hopper shown in Fig. 20, from which it was drawn as needed for each pile into the depositing bucket. This is of special design and is shown in Fig. 15. It holds just enough concrete in one charge to fill 3 ft. of the pile. Because of the shape of its lower end and the design of the dumping gate, each time this bucket was lowered into the pile it penetrated into the surface of the concrete already deposited. This effected the discharge of the new concrete below the existing surface and reduced considerably the formation of laitance. The concrete was a 1:2:4 mixture using ¾-in. gravel as coarse aggregate. About 3½ hr. were required to concrete a pile.

Cutting of Pipe—When concrete had been deposited to the cutoff level the pipe was cut off at El. 195 by means of an internal pipe-cutter of special design. This consisted of a cutting head as shown in Fig. 16 at the end of an 8-in. pipe. The extension and flange beneath it acted as a spacer to insure the cutter being kept at a constant elevation above the top of the concrete. A 2-in. pipe extending down inside the 8-in. pipe operated an expander in the cutter by which the cutting dies were fed outward as they penetrated the wall of the pipe. This cutter was at first operated by hand power at the end of an arm attached to the 8-in. pipe where it projected above the upper end of the pile. After the first few piles, however, steam power was used as shown in Fig. 16. It required about 6 hr. to set up the cutting plant, to cut a pipe, and then remove the plant.

After each pipe had been cut the upper section was withdrawn. To do this the pipe was capped by a wrought-iron cap and compressed air led into it. The upper section was then jarred loose by one of the well-drilling machines and by the air pressure inside the pipe.

Work on this foundation was begun on Aug. 1, 1922. At the present writing all the pipes except one have been driven, filled and cut off, and it is expected that all will have been cut off by Mar. 1. The average force employed has been about 35 men throughout 24 hours.

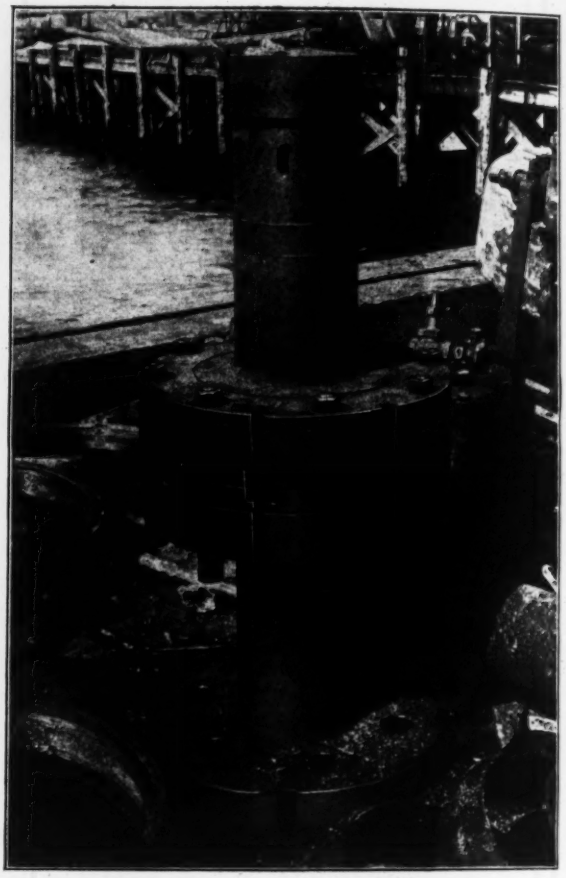


FIG. 21—INTERNAL PIPE-CUTTER

This specially designed tool was used to cut off the 24-in. pipes 105 ft. below m.h.w. The central head, containing the cutting tools and clearing disks, is revolved by means of the 8-in. pipe which extends up through the 24-in. pipe to the working platform.

Personnel—The work is being carried on under the supervision of the New York and New Jersey Bridge and Tunnel Commissions, Clifford M. Holland, chief engineer, Milton H. Freeman, engineer of construction, Miles I. Killmer, resident engineer on the work, and Ole Singstad, engineer of designs. Booth & Flinn, Ltd., are general contractors, for whom Leroy Tallman is general superintendent, Contract No. 4, and M. E. Chamberlain, chief engineer. The sinking of the piles was handled under subcontract by Sprague & Henwood of Scranton, Pa., N. R. Osborne, president. The tools and special equipment used in sinking the piles were designed and manufactured in the shop of the subcontractor.

Setting the Practical Limits of Terminal Unification

Analysis of the New York Port Terminals Problem to Determine a Reasonable Basis for Joint Terminal Facilities

By Frank R. Ford
Commissioner, the Port of New York Authority

Abstract of address delivered Sept. 21, 1922, before the Building Trades Employers' Association of Essex Co., N. J.

In December, 1921, the heads of the twelve standard railroads operating into New York sat on one side of a large table, in the Port Authority's office, and the six commissioners of the Port of New York Authority representing the states of New York and New Jersey sat on the other side, and unanimously agreed on the following as the first of nine fundamental principles needed for the port development: "Terminal operations within the Port District (New York) so far as economically practicable should be unified." As may be inferred from the language of this principle, there is a practical limit to the extent that terminal operations may be unified and it is of interest to determine just where this limit lies.

On the side of government, in order to lay down a comprehensive plan for economical port development, there have now been unified the several authorities of the federal government, of two states and, so far as desired by them, of 105 separate municipalities within the Port District. This unification is known as The Port of New York Authority, consisting of a commission of six members with officers and technical staff.

On the side of the railroads, terminal operations in certain places, including Chicago, St. Louis, Cleveland, Cincinnati, etc., have been unified as to the operation of certain facilities, including passenger stations, freight stations, warehouses, marine equipment, trucking, terminal bridges and belt lines. Under the stress of war, these and other railroad facilities were almost universally pooled by the U. S. Railroad Administration to increase efficiency, capacity and speed of operation.

The terminal problem in New York has become exceedingly complicated because of there being twelve standard railroads entering the Port District, in the main separately owned and operated, and each having its separate terminals, freight stations and port development. If these railroads were in one ownership and operation, there would be few problems except those of finance and design. This is exemplified in Brooklyn and Long Island where the Long Island R.R. is sole owner and operator. Another reason for the past delay in unification of rail terminals in and around New York is the wonderful system of inland waterways comprising its harbor, which form with the use of railroad car floats a "water belt line" that enables each railroad to reach all important parts of the Port District. But with increasing costs of operation, and with the need of deep-sea shipping for the waterfront in congested parts of the harbor, such as Manhattan and Jersey City, the time has come to augment this "water belt" delivery with facilities possessing greater efficiency and speed of operation.

Such improved facilities should include for Manhattan, freight operation by tunnel lines to freight stations and warehouses located away from the waterfront. All parts of New Jersey, Long Island and the Bronx within the Port District should be joined by standard belt line railroads connecting with all rail lines entering New York. The east and west sides of the port should also be joined by a freight tunnel line which the Port Authority has located under the Upper Bay between Greenville and Bay Ridge. Each railroad by itself would not be able to finance the large capital expenditures required for a separate modern freight terminal system of this character, nor would the limit of space in the congested areas and the necessity for enlarged capacities for future operations permit of more than one system of this character which therefore must be jointly used.

The railroads have in the past generation spent enormous sums upon new and extended passenger facilities and terminals in and around New York, and have improved their main-line tracks to a point of high efficiency, but during this period they have spent comparatively little on freight terminals in this section. Passenger traffic after all may be considered as a by-product of the commercial activity of a community which is represented by its freight traffic, and it is to care for the future growth of the freight terminal facilities that the Port Authority was created. When the railroad freight service breaks down, it occurs at the terminals and results in an embargo. In recent times of business activity this has occurred frequently in this port.

It is to remedy these antiquated, inadequate and separated port facilities that the plans of the Port Authority have been prepared. The need exists. The Port Authority has prepared physical plans as well as plans for financing and operation, and if the railroads do not consider them the best plans, they should present something better. The present Transportation Act maintains generally the competitive principle for railroad operations, but recognizes that in certain cases unified terminal operation is desirable and may be enforced by the Interstate Commerce Commission. Unification is most necessary in large metropolitan areas such as the Port of New York District where congestion is greatest, where construction costs are at a maximum and where the greatest need exists for expediting freight movement, for reducing terminal costs of operation and for enlarging terminal capacities for the future.

Now what is the practical limit for terminal unification? In the Port of New York District I believe this limit should include the following classes of service:

I. Joint services such as; (a) Interchange between railroads, or (b) Movement completely through the terminal area. This joint service should be provided by belt lines such as the inner, middle and outer belt lines of the comprehensive plan of the Port Authority, which would provide modern efficient facilities for these movements.

II. Service in congested areas such as Manhattan Island where there is; (a) Not sufficient physical area for separate service, or where (b) Separate terminals would involve too great expense for each company. This condition is provided for by the automatic electric system devised by the former bi-state Port Commission and adopted with modifications in the plan of the Port Authority.

III. Service requiring comprehensive deliveries over the entire Port District where use of equipment in joint operation would much cheapen the expense and facilitate the service. This service should include marine equipment such as tugs, lighters and car floats, and should include also store-door deliveries by a modern system of motor trucks.

IV. Service involving contact with great ship terminals with their attendant warehouses and industrial developments. These great terminals would include municipal terminal developments such as Port Newark, and private terminals such as the Bush Terminal which should not be served merely by one or two railroads.

The present freight terminals in the Port District are in many parts inefficient and antiquated and probably return directly to the railroad companies much less than a reasonable income. It is believed that in addition to reducing the already high terminal costs now paid by the public, unification to the extent outlined above would also produce an enlarged return upon the present railroad investment.

Under the Port Authority law of the states of New York and New Jersey as approved by the federal Congress, the Port of New York Authority has the right to own, construct and operate these terminal facilities or to lease them to an operating company under the supervision of the Port Authority. The securities to be issued by the Port Authority will be tax exempt but not guaranteed by either state, and hence will entail no charge on the taxpayers. The facilities constructed must by their economic savings provide for the interest on these securities. Consequently I believe that the Port Authority is in position to be of immediate and large help in the reorganization and reconstruction of these facilities and that this will result in a decrease in living costs both to the public and to the railroads.

Traveling Crane Has Turntable to Swing Locomotives

Engines Transferred from Longitudinal Shop Track to Transverse Track by Rotating Hoist on Trolley of Crane

AN OVERHEAD traveling crane which can revolve or turn a locomotive as well as carry it from place to place is a novel type of equipment installed recently in the River Rouge repair shop of the Detroit, Toledo & Ironton Ry. at Detroit, Mich. This crane, shown in Fig. 1, has a span of 56 ft. and a hoisting capacity of 100 tons.

In the layout of the shop, a longitudinal through track at one side, on which the engines enter and leave, serves transverse repair tracks and pits, so that it is necessary to swing each engine through a right-angle turn in transferring it to and from the repair track. This movement was effected formerly by the use of two traveling cranes, each with a single trolley, but the work was slow and inconvenient, since the two cranes were independent units and great care was necessary to operate them in unison when handling a locomotive.

To facilitate these transfer movements the new crane was designed, having its single hoisting trolley equipped with a turntable, so that the crane can perform four independent operations: (1) Hoisting, (2) longitudinal travel, (3) transverse travel, and (4) horizontal rotation. With this combination the crane can pick up a locomotive on the through track, carry it along the shop to the specified repair track, transfer it to the repair pit and finally lower it upon the repair track. A special advantage claimed is that the engine need not be raised high enough to pass over other engines, but need be raised only clear of the rails. The installation of this crane was much simpler than the provision of an outdoor transfer table to serve the repair tracks, besides which the pit for such a table would have taken up considerable yard space already required for other purposes.

The swinging operation of the traveling crane is effected by special construction of the hoisting trolley, which consists of two parts, as shown by the drawing,

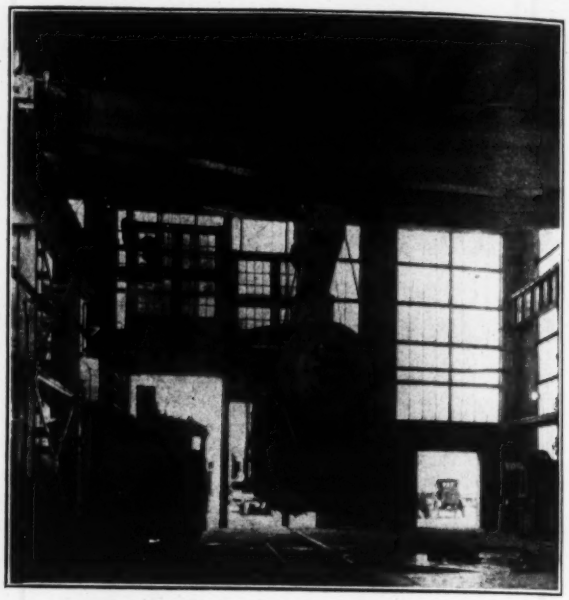


FIG. 1—TRAVELING CRANE TURNS LOCOMOTIVES
The hoisting drum is on a turntable on the traversing trolley and has two rope falls carrying a swing beam from which the engine is suspended by slings.

Fig. 2. The upper frame carries only the hoisting mechanism and has on its underside a combination ring gear and roller path. The lower frame, which is mounted on wheels on the crane bridge, has a set of conical rollers supporting the roller path and has also horizontal guide wheels to hold this path and the upper frame in position. On the lower frame are mounted two

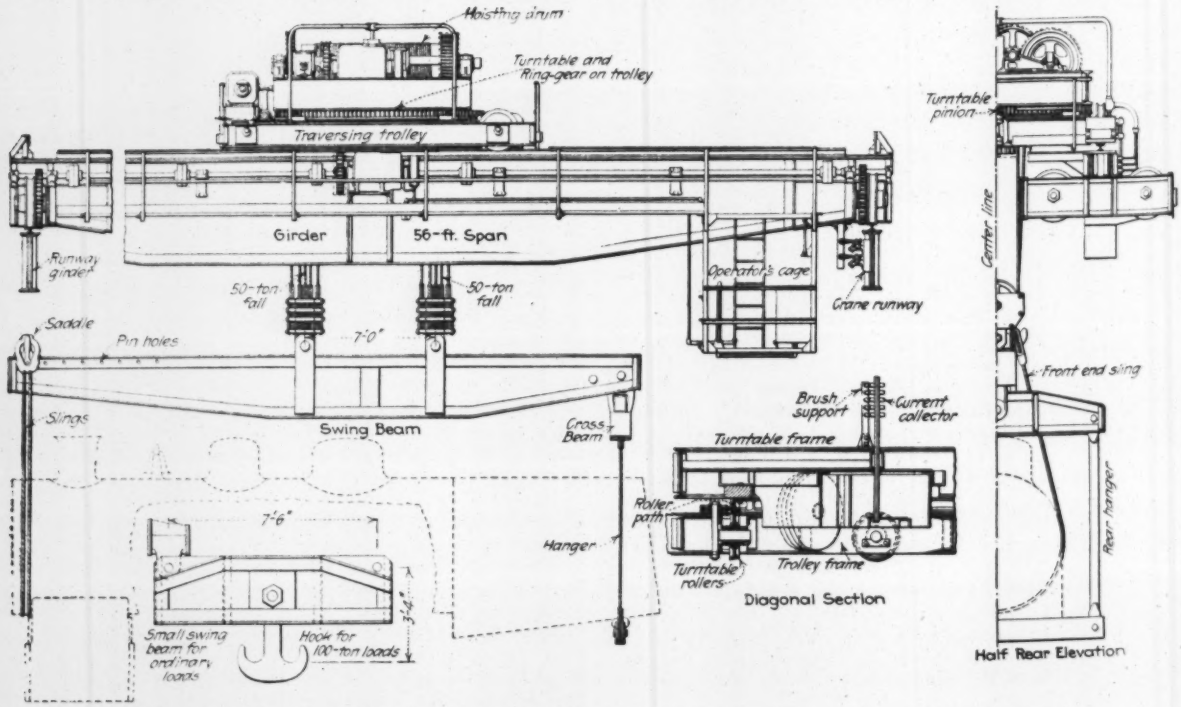


FIG. 2—TRAVELING CRANE WITH TURNTABLE HOIST MOUNTED ON TRAVERSING TROLLEY

motor-driven mechanisms for swinging and cross travel. The former drives a pinion engaging the ring gear of the upper frame. A complete revolution can be made in one minute, but in ordinary shop work only a half revolution is required for each movement. The crane bridge is of practically standard construction.

A long hoisting drum on the trolley carries two 50-ton rope falls spaced 7 ft. c. to c. and carrying a swing beam 34 ft. long. Adjustable slings on this beam provide for handling engines of different lengths. At one end of the beam is a pivoted transverse member with hangers to engage a cross beam placed under the engine frame, or under the firebox if a boiler is being handled. This rear sling has two positions of adjustment. A traversing saddle on the other end of the swing beam has two heavy horns for cable slings which engage the engine frames or the front end of the boiler. When this saddle is shifted to the desired position it is secured by a bolt through the swing beam. Since the two falls are on one drum the hoist operates as a unit. Provision can be made for an auxiliary hoist of smaller capacity, but such an attachment is not considered desirable on account of the possibility of its load interfering with the lifting beam. For other work than handling locomotives the long swing beam can be detached from the fall blocks and replaced by a 7½-ft. beam with a single 100-ton sister-hook (Fig. 2).

This combined revolving and traveling crane was designed and built by the Shaw Crane Works (Muskegon, Mich.) of Manning, Maxwell & Moore, Inc., New York, N. Y.

Cracks in Concrete Reservoir Forced by Icing Process

Ice and Salt Spread on Floor Hastened Cracking and Gave Opportunity to Forestall Leakage and Foundation Damage

A CONCRETE lined reservoir for storing part of the water supply of a small Western city was recently built during the summer months when temperatures were rather high. After the reservoir was finished and had stood empty for 60 days, about 60 lineal ft. of cracks appeared at construction joints in the floor. A few weeks later, with the reservoir roofed over and the concrete in the floor somewhat cooler, more cracks appeared until their total length was over 1,000 feet.

It was then decided that all the cracking that would be likely to occur should be made to develop quickly if possible so the cracks could be filled with waterproof compound and thus prevent the damage to reservoir foundation and the loss of water by leakage that could be expected if the cracks did not develop until after the reservoir was in service. In fact, the most extensive cracking was not thought likely to occur, if the reservoir were left to take its natural course, until the lowest temperatures of water were reached, which would be sometime during the winter when the reservoir would be full, of course. The ice treatment, described herein, within a few hours and at a very small cost, showed the exact location of 600 lineal feet of cracks in addition to the 1,000 ft. already mentioned. All the cracks were then cut open so they could be made watertight and after a thorough waterproofing job the reservoir was put in service with much more confidence as to its future performance than would otherwise have been possible.

The reservoir is circular in plan, 160 ft. in diameter, has vertical side walls 18 ft. high and is covered by a roof supported on columns extending up from the reservoir floor. The floor slab is 6 in. thick and was cast without any expansion joints.

A ton and a half of ice was brought to the reservoir, delivered to the highest point on the reservoir floor and broken up with a sledge hammer into pieces not exceeding about 6 in. in maximum dimension. The cracked ice was spread over the entire floor area with a coarse-bristle broom that would spread the cold water as well as the ice itself. A total of 250 lb. of rock salt was sprinkled over the broken ice as the spreading was being done. About 500 lb. of ice was broken up at a time and spread over an area of 500 or 600 sq.ft. After the ice had remained on this area for an hour or so inspectors brushed the surface clean and looked for cracks. Some of the cracks developed by this process were ⅛ in. wide. All cracks were marked their full length with white chalk.

SPREADING CRACKED ICE ON RESERVOIR FLOOR

The ice arrived at 11 a.m., was broken up and spread by one man and by 3 p.m. the 600 ft. of new cracks had been located and marked with chalk. The cost of ice, salt and labor was less than $20. Due to the heat of the surrounding air and concrete, the cracks which opened under the icing process all closed again within a few hours and were then not visible even with the aid of a microscope.

After the ice had all melted and had flowed out through the reservoir drain, a few hours were allowed for the floor to dry out thoroughly and then all cracks were treated with a special carbon mastic. Before applying the compound all cracks were first opened up with chisel to afford a V-shaped joint that would give the compound an opportunity to make an effective water seal in the cracks. When such work is done under cool or damp weather conditions, gasoline is ordinarily burned on the concrete to remove the moisture as most waterproofing compounds require a dry surface. On this job, however, due to the hot weather, the surface was dry enough for waterproofing in a few hours. The chiseling open of all cracks and finishing the entire surface with waterproof paint cost about $1,000.

Because the cold water temperature in winter will never be as low as that to which the pavement was subjected by the ice and salt, it is believed that no further contraction cracks will develop in the floor slab.

The repair of the reservoir was carried out by the Waterproof Paint Co. of Lankershim, Cal.

Water Consumption in New Jersey Declines

The average daily per capita water consumption in New Jersey was 114 gal. in 1914, 117 in 1918 and 109 in 1921, according to records compiled by the Water Resources Branch of the State Department of Conservation. H. T. Critchlow, hydraulic engineer, says the decline is due mainly to the increased use of meters. The population supplied in 1921 was about 2,950,000 and the volume 321,880,000 gal. daily.

The Present Status of Sewage Treatment in England—II

Impressions Based on Visits to Various Works and Interviews with British Specialists in January, 1923. Presented with a View to Current American Problems

By George W. Fuller
Consulting Engineer, New York City

Mr. Fuller's first article, published Feb. 1, p. 206, dealt with Administration and Public Policy Questions. The final article will be on The Outlook for the Activated-Sludge Process. In the present article Mr. Fuller shows that small detritus tanks, rather than the American type of low-velocity grit channels, are used in England, as also mechanically-cleaned racks rather than fine screens; that chemical precipitation is a thing of the past and that plain sedimentation and flow-equalization tanks rather than septic tanks are generally used, with separate sludge digestion as a notable feature of the Birmingham works; and that contact beds have lost the standing they had ten to twenty years ago, giving place to sprinkler beds, the latter being supplemented with humus tanks of larger capacity than at the outset.—Editor.

Status of Older Types of Treatment

THESE comments are directed toward certain basic principles. No pretense is made of dealing with numerous interesting details which might elucidate some of the English experiences, but which on the whole would probably obscure the vision in arriving at various ratings for certain types of works that are described at length in numerous local reports and set forth in various aspects in the reports of the late Royal Commission on Sewage Disposal. Such details, furthermore, would be beyond the scope of these notes in which it is sought only to record some of the outstanding experiences from practical operations on a sizeable scale.

At the outset the attention of the reader should be directed to the fact that practically all sewerage systems in England are built on the combined plan and that the dry-weather-flow (d.w.f.) usually ranges from 30 to 50 U. S. gal. per capita per 24 hours. During storms the authorities require that flows up to 3 × d.w.f. shall be treated as sewage and that flows from 3 to 6 × d.w.f. shall be treated as storm water.

Composition—The composition of the sewage in many English cities is materially influenced by the trade wastes which enter the sewers. The influence of this factor naturally varies greatly, as would be expected from the prevalence of different types of industries at different cities, such as cotton cloth mills at Manchester; wool scouring establishments at Bradford; woolen cloth mills at Leeds; steel mills at Sheffield; iron-working plants at Birmingham; and pottery works at Stoke. It is not easy to say how these wastes, varying greatly with different stages of industrial activity, influence the quantity or texture of the sludge or the readiness with which it is deposited as the sewage flows through the tanks. Neither is it known just how these wastes influence the separation of colloidal matters or the decomposition of organic matters or the formation of non-odorous compounds with the sulphur which in some form is bound to be released as bacterial processes effect the breaking down of organic substances into simpler forms. As to bacteria, it is probable that bactericidal influences are encountered in some instances, but it is remarkable how nature provides that bacterial processes can establish themselves on a regimen that is hard to upset. Gas-house wastes and strong acids sometimes prove bothersome but on the whole the bacteria play their part in the economy of nature surprisingly well.

Comparison of experiences with treatment works dealing with strictly domestic sewage and those receiving trade wastes as well indicates that, apart from the question of cost, the advantage is usually with the latter, at least so far as aerial nuisance is concerned.

Detritus Tanks—The English seldom use grit chambers, as is the case in America, where the mineral matter is separated in a series of channels at a velocity of 8 to 12 in. per second during a flow of from 60 to 100 ft. Instead, they install tanks holding 1/100 to 1/12 d.w.f. with little or no regard to velocity through them. The purpose is to deposit the bulk of the coarser solids where they can be readily and frequently removed by grab buckets or otherwise, without disturbing the regimen of the main tanks, or increasing the cost of sludging the latter. This program is negotiable in England where all sludge is ordinarily disposed of by barging to sea, pressing, lagooning or trenching on land. But these tanks afford a much greater clarification for the effluent of the detritus tanks than is the case with grit chamber effluents in America. Here is a factor which lessens to a substantial extent the apparent difference between the suspended matter in English and American sewages, due to different volumes of sewage per capita.

Screens—None of the so-called fine screens found in America and on the Continent of Europe were noted in England where are used only stationary bars, cleaned by moving rakes and brushes. The new plant at Leeds has screens with a ⅝-in. clear space.

Chemical Precipitation—So far as known chemicals are not used at any works to promote the deposition of solids in town sewage. During the war precipitants were not procurable. Now their benefits are not considered commensurate with their cost. At Bradford use is made of sulphuric acid to crack the grease entering the sewage from wool scouring works. This is a flotation rather than a precipitation process. Garfield says that he tried SO_2 about twenty years ago but adheres to the use of acid because it is more controllable, although somewhat more expensive.

Sedimentation Tanks—The effluent of detritus tanks is subjected to plain sedimentation in open tanks with floors having a slope of about 1 per cent. Sizes vary but several good recent designs show the capacity to be 15 to 18 hours in times of dry-weather flow, thus providing 5 to 6 hours for the storm sewage of 3 × d.w. flow.

Equalization Tanks—Storm flows from 3 to 6 × d.w.f. are treated as storm water. Local practice varies. In some cases in addition to storm-water tanks and filter beds there are quite large tanks in which storm flow

is stored for later application to the regular sewage beds. Surplus tankage from the days of septic tanks seems to be used at some places for these "equalization tanks." Full knowledge of sedimentation at English works calls for capacities of detritus tanks, sedimentation tanks and equalization tanks, and also a record of just how the several tanks are operated during dry-weather and wet-weather periods.

Septic Tanks—At only a few large works do tanks seem to be employed as formerly to serve jointly the purposes of clarification of the sewage and the digestion of the sludge. The open septic tank seems to have largely disappeared, partly because of air nuisance and partly because the managers desire a more uniform, convenient and economical program for sludge removal than is permitted by such tank operation. No new projects contemplate septic tanks so far as known. At Manchester some scum appears on the tanks during the summer as a feature incident to a convenient program for removing the sludge and barging it to sea. On the other hand Watson at Birmingham takes unusual care in summer to clean his sedimentation tanks about once a week and free them of all putrefying deposit that might so seed the sludge later to be deposited in them.

Two-Story Tanks—I saw no signs of any new installations of either Travis or Imhoff tanks, of which there were three or four installations each prior to the war. They seem to be regarded as expensive in comparison with single-story tanks, and not very adaptable to storm-water requirements. The Imhoff tank at the Withington works of Manchester is an efficient clarifying arrangement but produced much foaming at first and at intervals during its eight or nine years of service. The surface of the scum in the vents on Jan. 2 was about 30 in. above the flow line in the sedimentation chamber. Drying beds handle the digested sludge satisfactorily with about 1.5 sq.ft. per person served by them.

Separate Sludge Digestion—Probably the most impressive performance in satisfactorily handling the sludge of a large inland city is found at the Birmingham works where for over ten years Watson has operated his vast separate digestion tanks. These are rectangular, about 400 ft. long, 15 ft. deep, built of ashes, and lined with precast concrete slabs 2 in. thick. They are in two groups, one near the plain sedimentation tanks at Saltley and the other near Minworth where the sprinkler beds and humus tanks are located. There are two sets of pipes connecting each tank or basin with the neighboring pumping station. As undigested sludge is pumped into each tank great care is taken also to pump into the same 15-in. inlet pipe well digested sludge for seeding. In the tanks septic action causes a heavy scum to appear with clear water intermediate between it and the sludge at the bottom. It is the intent to have the sludge remain 2½ months in one tank when the contents are completely removed to a second where the digestion period is also 2½ months, making a total period of 5 months. The secondary tanks are at Minworth where the sludge from the humus tanks is daily discharged to the digestion tanks. The sludge from a million people is dried on 50 acres of ash beds, filled 3 or 4 times per year to a depth of 18 in. This is removed as a layer about 6 in. thick of air-dried sludge with a water content frequently as low as 35 to 40 per cent. As soon as the sludge layer is dry enough to walk upon a shovel hole is dug every 5 ft. or so in each direction to let rain water disappear. In this way each year some 400,000 tons of wet sludge is reduced without odor nuisance at either tanks or drying beds to some 35,000 tons of about 40 per cent air-dried sludge, having an organic nitrogen content of 1.5 to 2.5 per cent, dry basis. Watson sells this for 3½ shillings per ton as a fertilizer filler. A recent contract for a small quantity is for 5 shillings per ton. (Unless otherwise stated long tons of 2,240 lb. are indicated throughout this article.)

Sludge Barging—Barging to sea is still the method of sludge disposal in use at London, Manchester and Salford. The annual costs at the Davyhulme plant at Manchester last year were about £33,670 for sending to sea 203,206 tons of wet sludge.

Sludge Lagooning—This is practically an uncontrolled arrangement for separate sludge digestion—which I found Watson had been using in 1912. It is now being used by Bolton at Bury with satisfaction other than for disturbances formerly encountered at intervals from heavy accidental discharges of black ash from chemical works. Compared with the present Birmingham program its principal disadvantage is the absence of seeding all entering sludge with proper kinds of bacteria. Further, when an area is completely filled it is necessary to move to another location, unless the expense of removing wet sludge is met. Against these disadvantages of lagooning are questions of economy, when compared with the present Birmingham program.

Sludge Trenching—This is a well-known method which I found in use at the Withington works, Manchester. Sludge is applied to trenches dug by hand 3 ft. wide and 18 in. deep and is covered with the aid of a plow. Unless the soil is fairly porous the drying period is quite long and the required area is larger.

Sludge Pressing—Makepeace is pressing a mixture of sludge from all his tanks at Tunsall and Hanley. When the activated-sludge plant at the latter place goes into service he will deliver the surplus sludge to the inlet of his detritus tank which holds two hours flow, dry-weather basis. The mixed sludge will be pressed. At the new works at Leeds, Hart will press a mixture of sludge from the primary sedimentation tanks and his humus tanks following sprinkler beds. This primary sludge here does not press as well as formerly, due to the shutting down of discharges of lime and ferric chloride, thus probably requiring at times the addition at the press house of both lime and iron. The sludge cake will be used as formerly in filling low land. After thorough drying there is a limited market for the sludge on land needing lime. Screenings are sold to rhubarb growers.

Sludge Utilization—The outstanding experience in England in this field is that of Garfield at Bradford. During the war he sold annually about £150,000 sterling of grease, of which sum perhaps £50,000 was net. Now the market is poor but he is producing 20 to 25 tons daily of 98 per cent grease which in limited quantities can be sold for £8 10s. per ton. This is nearly down to pre-war prices, although labor and supplies for production are nearly double. Before the war he was selling much pressed sludge cake with about 2 per cent nitrogen content to France, but transportation charges have killed that enterprise. I was interested to note that he was running his own boiler plant with dried sludge cake and melted grease. To crack the sewage

and get the grease to rise to the surface of the flotation tanks he adds sulphuric acid in quantities to show an excess of acid to methyl orange indicator of 80 to 120 p.p.m. This figure varies a good deal with the different volumes of sewage flow and of wool scouring wastes in it. The judgment of the trained attendants as to "cracking reaction" seems to be guided more by observation than by the results of chemical tests, which do not seem to be enhanced by observations of the PH point.

Contact Beds—These beds are not entitled to the standing which they had twenty or even ten years ago. The reasons are that their total cost is too much for the work done and that they are relatively unadaptable to increased loadings at times of storm flows. They have suffered from containing too much fine material but it is doubtful if for large plants their adoption is ordinarily warranted in the light of present knowledge, even if by their use pumping is avoided, when compared with other types. Some contact beds are being cleaned for the third or fourth time, and in some instances are being converted into sprinkler beds, as at Bury. Cleaning operations are influenced somewhat by the unemployment question, but are being fairly held at a minimum at Sheffield, pending the construction of activated-sludge plants, and at Manchester, where the latter method is being actively investigated with two units in service and a third unit now building. Where such a shift in type of plant is made, it is on the basis that it is cheaper to install the activated-sludge method than to recondition the contact beds. I saw no signs of use of the American custom of installing contact beds for small residential communities or institutions, whereby beds are built of 1 to 2-in. stone, filled through open-jointed tile lines laid beneath the surface of the stone, and followed by humus tanks and sand beds.

Sprinkler Beds—These beds, variously called percolating or trickling filters, have shown an excellent record in England. The beds of coarser material have shown no signs of serious clogging and those of fine material have a better record than contact beds. During storm flow the English sprinkler beds seem to work satisfactorily at double the dry-weather flow or double the maximum daily rate of dry-weather flow. Flies have seldom proved bothersome and are said at Birmingham to be controllable by emptying the influent pipe system and applying a single dose of chloride of lime solution. Beds of fine material do not have fly complications and do not require any following humus tanks. Against this are the costs of raking and scraping fine beds and their ultimate removal and washing. During hot weather objectionable odors have been noted in the vicinity of several works of this type and this has been a factor in the abandonment of septic tanks and in the adoption of methods of preliminary treatment whereby the sewage is sent to the beds in as fresh a condition as practicable. While spray jets have not been given up, it is noteworthy that traveling distributors are being installed at most of the new works. In some instances, as at Leeds, this is said to be due to cheaper cost. At Birmingham I understand that work will soon be started on an activated-sludge plant to be installed at Minworth to treat the influent of the sprinkler beds. This is to remove colloidal matters and put the filter influent on an oxidizing basis at all times. The aerating tanks will hold about one hour's dry-weather flow. The Minworth filling beds are 43 acres in area, 6 ft. deep, of material 1 to 2 in. in size. They serve a population of about 850,000, a loading of 3,300 persons per acre-foot.

Sprinkler beds are a part of the two largest sewage-works now under construction. At Leeds, Hart is building 30 acres of 6-ft. beds, with the stone or gravel screened to between 1 and 3 in., to serve about 500,000 population, the sewage from which is highly charged with trade wastes. Garfield has recently started to build 60 acres of sprinkler beds for Bradford, 6 ft. deep, of fine coal, say ¼ to ¾ in. The beds will clog sooner or later but instead of washing the clogged coal he proposes to remove and burn it, restoring the beds with new coal. He is thus developing a coal storage project, which is not without its advantages in a large industrial center. As a foolproof arrangement the sprinkler bed is entitled to the highest rating.

Humus Tanks—These tanks are being built somewhat larger than formerly and more effort is made to check quickly the inlet velocity. They are mostly of the Dortmund type, with hopper bottoms and peripheral outlet weirs. The slopes usually range from 50 to 60 deg. Vertical velocities are to be kept at less than 8 ft. per hour at maximum rate of flow. The Leeds tanks will contain 6 hours d.w.f. and the aim is to provide a detention period of two hours during maximum flows at times of storm. Sludge is ordinarily removed daily.

Land Treatment—Not much is heard of land treatment for the main flow of sewage, as distinguished from sludge, although some of the older engineers still adhere to the earlier view that ample land areas do much towards stabilizing at times the performance of sewage-works. On the other hand, when land is overdosed and it becomes "sewage sick" real nuisances are produced. This is said to have been the experience of the sewage farm at Withington and it is understood that similar experiences were had at Aldershot where army activities greatly overtaxed local facilities. Mention has already been made of applying sludge to land in trenches or in lagoons and more will be said in connection with the activated-sludge process.

In passing mention may be made of the use of artificially prepared land at Chester on which a part of the excess flow of sewage was found to be applied. About five acres of a refuse dump some 6 or 7 ft. deep have been arranged as intermittent filter beds to which settled sewage is said to be applied in doses of about 75,000 gal. per acre. (Unless otherwise stated Imperial gallons are used throughout this article.)

A Peculiar Reinforced-Concrete Building Failure

An unusual cause of failure of a reinforced-concrete building under construction at Hersfeld, Germany, is reported in *Beton und Eisen*. The structure was a two-story factory building, with columns, floors and roof of reinforced concrete. The entire reinforced-concrete work had been completed, and on the day of the accident the forms were stripped. While the concrete was setting, with no men on the job, an iron erector working on an adjoining building attached to the base of one of the column forms the tackle for lifting up some 70-ft. steel roof trusses. The horizontal pull of this tackle on the form while the concrete was green destroyed the integrity of the column, it is believed. When the forms were removed there was a large diagonal crack in the column near the base, and an hour later the structure collapsed, killing five workmen.

Street Intersections Mapped Out by Means of Contours

Contour Diagrams Explained—Working Out Grades at Intersections—Example Illustrating Difficult Grade Combination

By F. S. Besson

Major, Corps of Engineers, U. S. A., Assistant to the Engineer Commissioner, District of Columbia

Copyright, 1923, by F. W. Besson

AN UNDERSTANDING of roadway shapes is helped by making contour diagrams. Fig. 1 illustrates four cases: two with curbs at equal elevations, one case having a longitudinal grade, the other none; and the remaining two with curbs at unequal elevations, one case with and the other without longitudinal grade.

Surface drainage flows to the gutters along lines normal to the contours, and the slopes along these lines are combinations of the longitudinal and transverse grades. This is the reason that the transverse grade should decrease as the longitudinal grade increases, otherwise unreasonably steep slopes toward the gutter are introduced. A roadway on a longitudinal grade corresponds to a topographical ridge and the contours are always convex down hill. Contours convex uphill outline valleys and are met with only at roadway intersections. Even there, except in the vicinity of catch basins, every effort should be made so to merge the roadway surfaces as to introduce as few contours, convex uphill, as possible.

After a little experience intersections can be mapped out quickly and successfully by means of contours. One inch equals ten feet is a good scale for an intersection plan since then an engineer's scale may be used in laying off contour intervals along the gutter and other grade lines. For instance, with a 6 per cent slope and 0.1 ft. vertical interval, the sixty parts to the inch scale reads to hundredths of a foot in elevation, and a space of ten-sixtieths on the scale represents the contour spacing. Similarly a space of twenty-fiftieths on the fifty parts to the inch scale represents the contour spacing for a V.I. of 0.1 ft. on a 2.5 per cent slope; and the engineer's scale in like manner has a wide application. Scales for slopes, for which the engineer's scale cannot be used, can be provided by using cross-section paper with ten divisions to the inch. The spacing of the horizontal lines on the paper may be assumed to be 0.1 ft. For example, if a 2.3 per cent slope is drawn, the abscissas of the points of intersection of this slope with the horizontal lines give the contour spacing.

Grades at Intersections—Working out the grades for street intersections requires judgment, the exercise of which may be somewhat elastic as regards details. Certain general rules may be stated, however, and these can best be explained by examples. After determining the grades, a contour map of the intersection serves as a check since from it the engineer can picture the appearance of the completed pavement.

In Fig. 2, a 40-ft. roadway on a 4 per cent grade, is intersected by a 30-ft. roadway on a 1 per cent grade. These grades having been originally established only along the center lines of the roadways are increased slightly, where they traverse the blocks between intersections, by any flattening that may be necessary within the intersections. The original center line grades are, however, close enough approximations for determining the cross-section from the formula $T = 0.266\ (16 - L)$, in which T = the transverse grade from the quarter point to the curb, $\frac{T}{2}$ = the transverse grade from the quarter point to the center line, and L = the longitudinal grade. For the sections Aa and Bb, with L = 4 per cent, we have T = 3.2 per cent and for the sections Cc and Dd, with L = 1 per cent, we have T = 4 per cent.

The easiest point to begin working grades is the corner of the intersection, cB, where two descending grades meet. A catch basin has to be placed at this corner and the elevations of the tangent points may be approximately equal. With assumed elevations for the tangent points of curb at a corner, intermediate points may be determined as in Fig. 3. Produce the longitudinal grades 4 per cent and 1 per cent of the tangents,

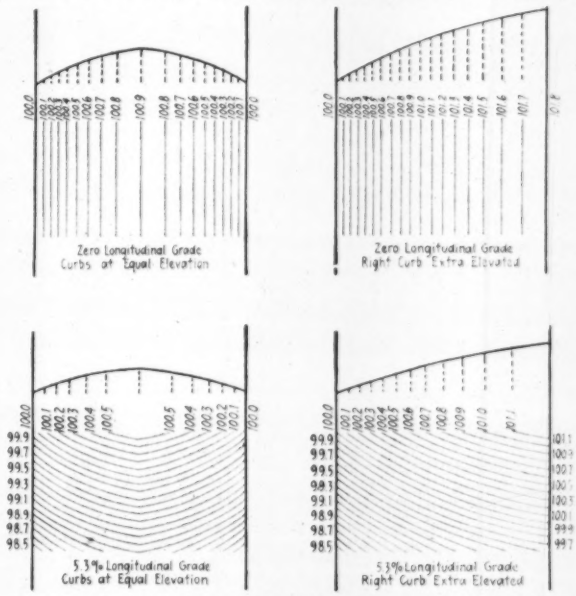


FIG. 1—FOUR ELEMENTARY ROADWAY SHAPES, REPRESENTED BY CONTOURS

to I, their intersection in plan. Compute the elevations at this intersection. If the elevation of B is 100, the 4 per cent grade gives 99.60 at the intersection; and with C also 100, the 1 per cent grade gives 99.90. By drawing intermediate tangents to other points on the circular curb the elevations of these points may be readily computed as indicated. Often in the field, curb setters use this method. The curb tangents are produced by stretching strings, with other strings indicating the intermediate tangents. Laying off on these latter the distances to their tangent points establishes the circular curb elevations.

The maximum permissible difference in elevations at the intersection, in plan of the grade tangents, is obtained when the tangent point elevations are equal. This difference at the intersection may be decreased to zero which gives the maximum permissible difference in elevations at the tangent points. In Fig. 3 the maximum difference at I equals 0.3 ft. and, when this is reduced to zero, the elevations along the connecting grade line are lowered as indicated by the second set of figures with 100 as the elevation of B, and 99.70 for c. Profiles along the curb for the two sets of elevations are shown at the bottom of the figure. If the 4 per cent and 1 per cent grades were ascending

toward the corner instead of descending these profiles would apply as convex upward instead of concave.

The profile with tangent points at equal elevations is usually a good one to use when it is necessary to provide for a catch basin at a corner. The profile at the other extreme (that is, with the grade lines intersecting in a single elevation at *I*) merges best with the longi-

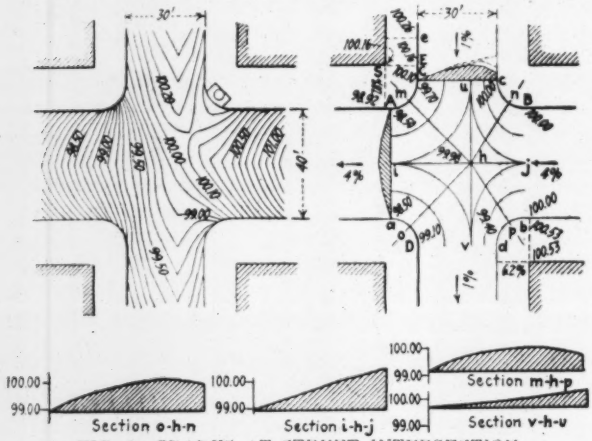


FIG. 2—GRADES AT STREET INTERSECTION

tudinal grades on the tangents. Often a profile has to be chosen lying between the two extremes, the choice being a compromise.

Returning to Fig. 2, while the necessity of a catch basin between *c* and *B* is one reason for not placing *c* lower than *B*, another reason is that, to do so would make a slight depression that would interfere somewhat with smooth passage from the 30-ft. roadway across the 40-ft. roadway.

Having tentatively determined the elevations at the corner of the intersection chosen for a point of beginning, the first question to be decided is, what cross-section to use for the 30-ft. roadway. The 40-ft. roadway is on the more important of the two streets and it is desired to carry it through with as little change in its 4 per cent longitudinal grade as practicable. This means that the right-hand gutter of the 30-ft. roadway has to be higher than the opposite gutter. The maximum extra elevation that can be given is obtained by the use of a section having a mean cross-slope of $\frac{1}{2}(T + \frac{1}{2}T)$ or 3 per cent, which gives a drop from *c* to *C* of 0.9 ft. A cross-section continuously falling from one gutter, across the roadway, to the other, is somewhat objectionable from the standpoint of appearance, unless the general lay of the land is steep—steeper than the 4 per cent of the present instance. As much rounded shape as practicable should be given a roadway and the cross-section drawn with a full line will be tried, which gives a fall from *c* to *C* of but 0.3 foot.

Now, if *L* on the 40-ft. roadway, across the intersection, is maintained at 4 per cent, the drop from *B* to *A* is 2.0 ft., thus giving a drop from *C* to *A* of 1.7 ft. and making the sidewalk slope so steep as to be objectionable. A 10 per cent sidewalk slope, though it may be exceeded under exceptional conditions, should ordinarily be assumed as a limit for corner locations at a simple intersection such as the present one. It is to be decided whether to reduce the sidewalk slope by lowering *C* or by raising *A;* the former by changing the shape of the cross-section *Cc*, the latter by reducing *L* across *B* to *A*. A reduction in *L* across the intersection increases *L* along the 40-ft. roadway traversing the block beyond the intersection. On important traffic highways, in cases where the grade is close to the maximum, and accordingly any increase would be objectionable, grades have been used as steep as 5 per cent across minor street intersections. Generally though, a 3 per cent limit should be adopted, which in the present example, based on a gutter elevation of 100 at tangent point *B*, gives a gutter elevation of 98.5 at *A*. A drop of 0.3 ft. from *c* to *C* gives a gutter elevation at the latter point of 99.7. A curb height of 0.5 ft. may be used at *A* and 0.4 ft. at *C*, thus taking up 0.1 ft. of their difference in elevation, and leaving 1.1 feet.

If *S* is the intersection of the building lines, a level line from *E* on the curb of the 30-ft. roadway gives a tentative elevation for *S*, since generally it is desirable to have *S* at least no lower than *E*. An elevation of 100.16 for *S* gives a slope of 7.8 per cent from *S* to *A*, the tangent point on the 40-ft. roadway. Other features of the intersection being properly taken care of it is well to have this slope as much less than 10 per cent as is practicable. If a satisfactory sidewalk slope

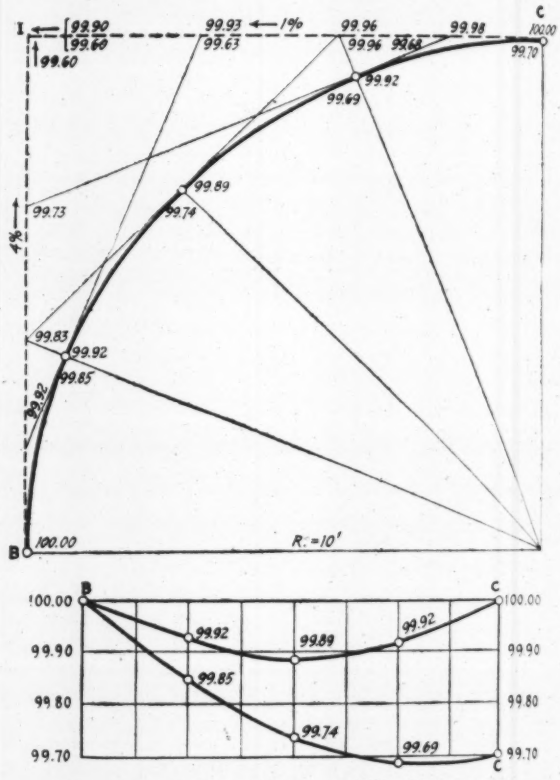


FIG. 3—MERGING GRADE LINES ON STREET
Where there are two elevations written at one point, the upper ones relate to $B = 100$ and $c = 100$; the lower, to $B = 100$ and $c = 99.70$.

above *A* can be obtained in no other manner, the break in the slope, which has been assumed along the line *SE*, may be moved further up the street, for instance to *e* at El. 100.26. This would mean that for the small area of sidewalk between this latter break and *SE*, drainage would be toward the building line. Even if there were an opening into a building just above *S*, a slight step-up at the entrance would stop water from flowing in, and since the slope past *S* and toward *A* is steep, drainage would be well taken care of. If buildings are well set

back from the sidewalks and only parking lines intersect at *S*, a coping between the grass and the walk would direct water from *e* at El. 100.26, past *S;* and in such cases it is very common to find the break in the slope a number of feet uphill from the line *SE*.

The next step is to decide on the cross-section of the 40-ft. roadway. This decision depends somewhat upon the lay of the land on either side of the street, but in view of the fact that the intersecting street is on only a 1 per cent grade, undoubtedly a symmetrical section will be satisfactory. Accordingly, with a gutter elevation of 98.5 at *A*, we may decide upon 98.5 for *a*. At *B* the gutter elevation is 100 and at *b*, also 100.

In making an assumption for the gutter elevation at *D*, it is desirable to have it such that a line drawn from *C* to *D* continues the 1 per cent grade. This gives 99.10 as the elevation of *D*. From *D* to *d* the same roadway cross-section is used as was adopted for *Cc*, and the gutter elevation at *d* is 99.40. It should be noted that the tangent points *C*, *c*, *D* and *d*, lie in a plane, and also that *A*, *a*, *B* and *b* lie in a plane.

The surface of the 30-ft. roadway is to be warped into that of the 40-ft. roadway. Circular curves are drawn between the grade lines in the roadways, connecting points in the sections *Aa*, *Bb*, *Cc*, *Dc*. Elevations along these connecting curves are determined as in Fig. 3, leaving in the center of the intersection a space still undetermined. This space is controlled by the central point *h*. Sections *mhp*, *nho*, *uhv*, and *ihj* all pass through the point *h*, and it is an easy matter to determine an elevation for this central point that will provide satisfactory shapes for these sections. The elevation chosen for *h* is a matter of judgment, but when the contours are drawn and desirable improvements become apparent, the elevations of points previously determined on the connecting circular curves may be altered.

A Difficult Example—Fig. 4 illustrates an acute intersection with a difficult grade combination. The east and west street with a 4 per cent grade is a 56-ft. traffic highway while the roadway of the diagonal local street is 30 ft. wide and is on a 6 per cent grade. Before proceeding with the discussion of grade determinations, it should be noted that the lengths of circular curb used at the four corners are equal, which balances the intersection in plan.

It is desirable to carry the traffic highway through the intersection with as little disturbance of its normal cross-section as practicable. The local street is of secondary consideration. The hill along the traffic highway is steep enough to justify an unsymmetrical section. The high point of the crown is placed 10 ft. from the uphill curb and *T* and ½*T*, in accordance with the formula, for *L* = 4 per cent, are taken as 3.2 per cent and 1.6 per cent, respectively. These values are used only on the uphill side of the crown, however; while, because of the exceptional layout of the intersection, 2 per cent and 4 per cent are used on the remainder of the cross-section, thus increasing what would be the normal difference in elevation between the uphill gutter and the downhill gutter. The cross-section of the local street is treated in like manner.

The intersection as developed gives close to the maximum permissible grades at the corners *A* and *D*. Undoubtedly though, at these acute corners the ground back of the sidewalks will be on such steep slopes that retaining walls will be necessary and, this being the case, plenty of length may be taken for the warping of one sidewalk into the other, thus making unnecessary excessively steep grades. A hair pin turn on the side of a hill, such as the present instance, of necessity entails more than ordinary grades on the turn; and sometimes the most practicable way to pass from the

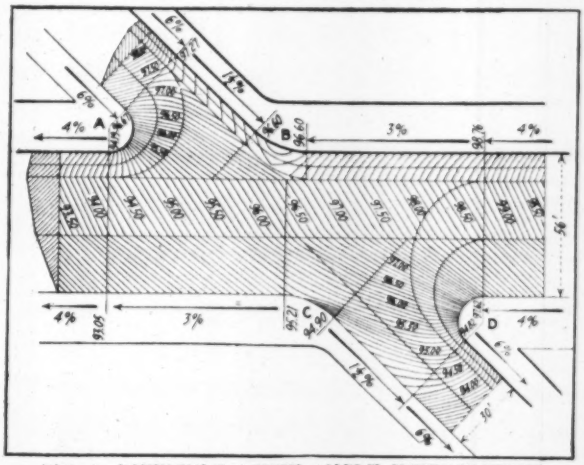


FIG. 4—DIFFICULT ACUTE ANGLE INTERSECTION

sidewalk on the lower street to that on the switch back is by means of steps.

From the figure it is seen that the traffic highway is favored to the extent of carrying practically one-third of its width clear through the intersection on an unbroken 3 per cent grade. It is apparent that if this were but a 1½ per cent grade, only one-half as many contours would be crowded into the corners *A* and *D*. Through his choice of roadway cross-sections and longitudinal grades across the intersection the engineer may introduce practically any desired sidewalk grades at *A* and *D*. A feature worthy of particular notice is that the points represented by 96.67, 97.27, 96.60, 94.82, 94.22 and 94.90 all lie in one plane; similarly the points represented by 95.21, 93.05, 94.19, and 96.60, 98.76 and 97.62 all lie in one plane.

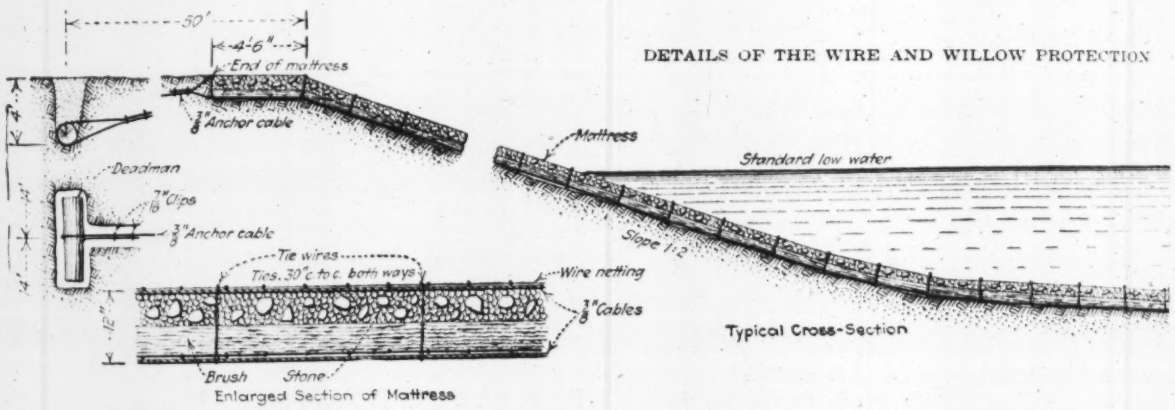
New York State Highway Bridge Statistics

Out of 33,800 highway bridges in New York State, a survey made some time ago shows that 67 per cent are 5 to 20 ft. in span, 24 per cent are 20 to 50 ft. in span, and 9 per cent are over 50 ft. Only 3,587 bridges are located on state or improved county roads, while more than 30,000 are on township and unimproved county roads. The former were separately inspected for the purposes of the survey, and is was found that 2,500 bridges (average length about 25 ft.) had a load capacity of 15 tons or over, while 1,090 bridges (average length 32 ft.) had less than 15 tons capacity. As to condition, is was estimated that about 75 per cent of them were in good condition, 15 per cent in fair condition, and 10 per cent in poor condition, while most of the bridges on township and unimproved county roads were in poor condition. A special inspection was made of 251 bridges on three principal state highway routes; less than half were found capable of carrying a 15-ton load, and 51 had a capacity of 5 tons or less. There were found among the number three bridges that had been condemned, and five others that were in unsafe condition. The annual expenditures for bridge construction and repair on state and county highways have for over ten years exceeded $1,000,000, while they were nearly $3,000,000 in 1920 and $2,500,000 in 1921.

Wire and Willow Mat Revetment on the Missouri River

Wabash Railway Protects Its River Line Against Erosion—Wire Mesh Encloses Brush and Rock—Force and Equipment

BANK revetment with a continuous flexible mattress composed of two layers of wire mesh with filling of brush and rock has been applied recently at two points along the Missouri River below Kansas City, Mo., where bank erosion threatened the Wabash Ry. This protective system was developed in 1915 by A. O. Cunningham, chief engineer of the Wabash Ry. (see *Engineering News*, Nov. 30, 1916, p. 1022). It has been applied at several points, but the recent work is somewhat modified from the original design by the use of heavier wire mesh. Work done in 1921 and 1922 includes 2,000 ft. at Hull's Point, Mo., about 27 miles east of Kansas City, and a stretch of 1,000 ft. at DeWitt, 65 miles below Hull's Point. At these places the railway track is 75 to 400 ft. from top of bank.



DETAILS OF THE WIRE AND WILLOW PROTECTION

Hydraulic grading of the river bank is the first step, dressing it to a slope of 1 on 2, or 1 on 3 where the distance from the railway is sufficient. This slope extends from low-water level to top of bank, an average height of 15 ft. For this grading there is a pump scow 19 x 70 ft. with cabin enclosing a 100-hp. boiler and a duplex pump giving a pressure of 140 to 160 lb. in a 4-in. hose line about 100 ft. long. A ¾- or 1-in. nozzle on the pipe is manipulated by an operator on the bank. In the ordinary earth, clay and sand encountered on this work the progress averages about 5,000 square feet in a 10-hour day.

COMPLETED MATTRESS AT DeWITT, MO.; WABASH RY.

Galvanized wire netting of 6-in. rectangular mesh and composed of No. 9 wires is used for the mattress. In some of the earlier work triangular mesh fabric was used, having No. 10 longitudinal wires and No. 12 or No. 14 for the web diagonals. Experience has shown that the heavier wires give longer life and better service, especially for that portion of the mattress which is above the low-water line. The mesh, 4½ ft. wide, is delivered in rolls of 330 ft.

In construction, the bottom layer of mesh is placed with the 4½-ft. strips parallel to the channel, the adjacent strips being sewed together with No. 9 soft galvanized wire to make up the required width. A 6-in. layer of willow brush bundles at right angles to the channel is laid on the wire, and then a second layer of bundles parallel with the channel. Rip-rap stone is distributed uniformly over the brush and then the top layer of netting is placed in strips at right angles to those in the bottom layer. Vertical tie wires or stitches of No. 9 soft galvanized wire are then placed 30 in. apart in both directions and are drawn tight by means of a special device. These tie wires bind the upper and lower mesh firmly together, holding the stone in place so as to prevent shifting of this ballast when the mattress is launched.

Bar-growth willows from ¾- to 1½-in. in diameter are placed in the original bundles, which are 6- to 10-in. in diameter and 8 to 25 ft. in length. Care is taken to break joints. Riprap stone ranging from 20- to 125-lb. pieces is placed usually by hand from barges for the submerged portion and from the bank for the shore portion of the mattress. Wheelbarrows are used in some cases for distributing the stone.

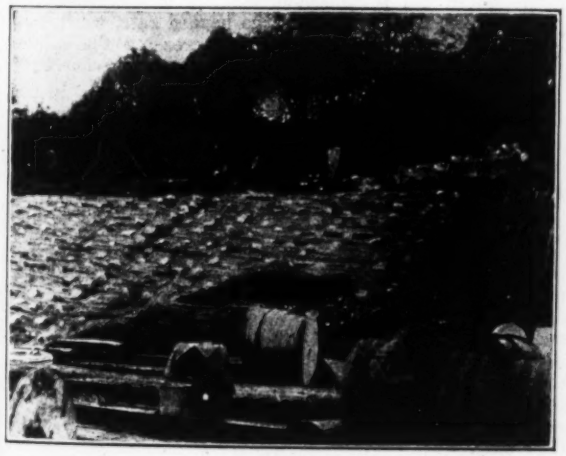
When this type of revetment was first introduced the mattress was carried up to the low-water line, above which the slope was paved with rip-rap stone. In recent work, however, the railway has had the mattress extended to the top of the bank, as shown in the drawing, since it is less expensive than stone paving. If protection is needed after the life of this exposed portion, the mattress can be renewed or stone paving laid, as may be desirable. Where the bank is unstable and has a tendency to slip or slide, the mattress protection has an advantage over stone paving in that it places much less weight on the slope. Anchor cables of ⅜-in. galvanized strand are placed entirely across the mattress at intervals of about 14 ft. and attached to deadmen, as shown.

That portion of the mattress which is to be submerged is built on a barge provided with steel sills laid across the deck and having their ends on the upstream side curved downwards to assist in launching the mattress. In starting the revetment a roll of brush poles and rock is built to a diameter of 15 or 18 in. for the full width of the mat and is attached to ½-in. cables led upstream to deadmen or anchors. To this is connected a 20-ft. length of mattress, built up as described. When this section is completed, the barge is pulled downstream by means of a cable and steam capstan, thus launching the mattress into the water.

That part of the mattress above low-water line is built in place and continuous with the portion placed from the barge. This part of the mattress usually silts up after a rise of water in the river.

Floating equipment varies according to the length of haul for willows and rock, which for the Hull's Point work was about two miles. For a contract of moderate size this equipment comprises usually the following: Quarterboat to house and feed a crew of 40 men, a steam or gasoline towboat, a pump scow for grading the bank, a mattress barge 24 x 80 ft., three brush barges 24 x 100 ft. and two rock barges 20 x 100 ft.

About 15 men are required in building the 70-ft. width of mattress on the barge, and 15 to 25 men for the mattress above low-water line. The standard width of mattress as built on the barge is 70 ft., but it has been built to a width of 100 ft. Its weight averages 222 to 250 lb. per square foot in air. About 100 ft. of 70-ft. mattress are built and sunk in a 10-hour day. For each 100 square feet of mattress there are 200 sq.ft. of wire mesh, 20 tie wires 5 ft. long, 50 lin.ft. of ⅜-in. cable, 45 lin.ft. of lacing wire, ¾-cord of brush and ½-cu.yd. of stone. One deadman is provided for each 1,200 sq.ft. of mattress. This consists of a 12-in.



BUILDING SHORE PORTION OF MATTRESS

log 4 ft. long buried in a trench which is thoroughly backfilled and tamped.

None of the revetment has been in use long enough to determine its life. The work done in 1915 with the lighter type of wire mesh is in good condition where it is silted up. Where it is exposed, some of the No. 14 wires are broken, but the heavier wires now used will give a longer life. An extra cast of galvanizing would also help toward longer life. This type of mattress adjusts itself to irregularities in the bed of the stream; it also can be laid at high or flood stages in the river. To protect a bank which is being undermined the mat can be built on top and allowed to fall as a protective curtain when the bank caves in beneath it.

This work on the Wabash Ry. is done under the direction of A. O. Cunningham, chief engineer, the designer of this system of protection. The field work is in charge of William H. Bush, drainage engineer, Wabash

BUILDING WIRE AND BRUSH MATTRESS ON BARGE

Ry. The contractor is the Kansas City Bridge Co., with George F. Maitland as its engineer of construction. In addition to its use on the Wabash Ry. this type of mattress revetment has been used by other railways, by the Prairie Pipe Line Co. to protect its submerged oil-pipe across the Missouri River, and by the Little River drainage district on 900 ft. of its main diversion channel near Cape Girardeau, Mo.

To Minimize Stresses in Laminated Wood

Extensive tests have been carried out at the Forest Products Laboratory, Madison, Wis., for the National Advisory Committee for Aeronautics, to study the factors which produce internal stress in wooden members built up by gluing together thin sheets of wood. These internal stresses are of greatest importance in airplane propellers because of the high service stress. It was found that expansion and contraction due to moisture variation differ in radial and tangential directions in all species of wood tested, but least so in mahogany, where the amount of shrinkage from green to oven-dry condition is a little over 5 per cent tangential and between 4 and 5 per cent radial, while for North American hardwoods the tangential shrinkage ranges from 7 to 10 per cent and the radial shrinkage from 4 to 7 per cent. The ratio of the two shrinkages affects the action of laminated members containing both plain-sawed and quarter-sawed material. The investigators (A. L. Heim, A. C. Knauss and Louis Seutter) recommend in their report on the tests (Report 146, National Advisory Committee for Aeronautics) that all propellers be covered with aluminum leaf or other moisture-proofing, that propellers for extreme service be made wholly of quarter-sawed stock, that for moderate service all plain-sawed stock be used, that the mixing of plain and quarter-sawed stock is permissible for moderate service when the ratio of radial to tangential shrinkage is not lower than 0.75, and that care be taken to keep the moisture content of wood under all conditions below 15 per cent, to prevent softening of the glue and separation of the laminations.

Technical Progress of A. G. C. Shown By Committee Reports

Associated General Contractors Receive Constructive Reports on Contract Forms Seasonal Labor, Immigration, Apprenticeships and Cost Estimating

ORGANIZED activities of contractors are represented in a remarkable way by the reports of the committees of the Associated General Contractors of America in convention last week at Los Angeles, Calif. Except four of these reports relating to internal affairs of the association, all have an industrial and technical significance of wide concern. In particular the reports on methods, on legislation and on labor, interest construction engineers. Outstanding as a specific committee accomplishment is the joint agreement with the committee of the American Association of State Highway Officials on equitable provisions of highway contracts.

Internal Affairs

About a 50 per cent growth in twelve months is reported by the committee on membership. Exactly, the increase is 525 new members but as 175 members have been lost the net increase is 350 and the total membership is 1,404 compared with 1,054 at the beginning of 1922. There are now 33 chapters of the association, 13 of which were added in 1922. The continuation of the *Index*, the *Constructor* and the *"News Letter"* as periodical publications is recommended by the committee on publications. Stating its duty to be primarily to act as a jury on fair dealing the committee on ethics offers the Golden Rule as the complete code of ethics of the association.

Contractual Relations

Bonding practices, uniform contract forms and fair practices in highway contracting were constructively presented in three reports of such length that conclusions only may be given.

Uniform Contracts—As a result of the past year's work the committee on contracts makes the following recommendations:

1. That the work of the Joint Conference on Standard Construction contracts be continued, and that contractors in each locality through local conferences urge architects and engineers in their districts to become thoroughly familiar with the work of this contract conference and give it their support.

2. That contact be made with the American Institute of Architects for the purpose of adopting a standard form of proposal for private building work, and to confer upon other matters of mutual interest in the building field, falling outside the scope of the Joint Conference.

3. That a standard form of subcontract and proposal be drawn up jointly with subcontractors to enunciate principles in accordance with those of the major contracts.

4. That the standard document of the American Institute of Architects should receive official approval of the A.G.C. pending final adoption of the Universal Forms, and that members of the A.G.C. insist upon the use of these documents for building contracts.

Bonding Practices — Public lettings are seriously demoralized by the present bonding practice. The three principle points brought out by criticisms are as follows:

First, the determination of responsibility does not rest with the public official, but is fixed by the qualifications of any bidder who can secure bonds.

Second, bonds, especially bid bonds, are given so promiscuously that almost any person desiring to bid on construction can make the necessary bonding arrangements.

Third, to cover the inevitable losses of promiscuous bonding, the premium has been raised some several hundred per cent in the last few years.

Whether the practices complained of are universal or whether confined to certain companies, in any event the entire bond situation appears to need a thorough investigation.

The present demoralization of public lettings and the failures of performance that are common in various types of construction, are a strong reminder that it is in the interest of all three parties concerned that any injurious practices in the bonding market be discontinued. The committee recommends that the Association attempt to investigate this matter in co-operation with public officials and representatives of the bonding companies, and that a joint committee of these three interests if possible, report upon the means of establishing sound economic practices and a code of ethics in the field of contract bonding.

Equitable Highway Contracts—Working with a committee of the Association of State Highway Officials with W. R. Neel, state highway engineer of Georgia, as chairman a special committee headed by H. J. Wilson, Winston & Co., of the Associated General Contractors agreed upon the following recommendations:

1. *Contract Surety*—That where permitted by the law the highway department permit the substitution of approved negotiable securities for bond; the value of the securities deposited, except in extremely hazardous work, to equal not more than 35 per cent of the contract amount.

(The exclusive use of surety bonds is believed to have resulted in the promiscuous bonding of irresponsible contractors, thus increasing the hazard rate, which in turn has been met by greatly increasing the bond premium; also the fulfillment by the surety frequently entails many difficulties of legal procedure.)

2. *Bidders Bond*—That proposals for highway work require that no bidders bond will be acceptable, unless accompanied by satisfactory assurance that the surety will bond the bidder for the contract, if awarded to him.

(The promiscuous writing of Bidders Bonds, which, in some localities, carry no assurance that the surety will bond the contractor for the work, is believed to exert a demoralizing influence upon public lettings.)

3. *Payments*—That where possible, monthly payments be made not later than a definite calendar date; that final payment be made within a specified time after the contractor has fully performed his contractual obligations; or where final payment is necessarily delayed, that a semi-final payment be made in such amount as the department may consider safe.

(Construction companies are bound to material manufacturers and other commercial concerns by auxiliary contracts, which require payment within a limited time, and failure of the department to make prompt payments to the construction company may entail difficult emergency financing.)

4. *Acceptance of Work*—That portions of the road, when satisfactorily completed, be accepted and paid for in sections of reasonable length, and maintenance by contractors terminated.

(Funds retained by the department after portions of the work are satisfactorily completed, involve unnecessary interest charges in the cost of construction and complicate its financing.)

5. *Maintenance* — That the maintenance guarantee on highways, after they have been accepted, be divorced from the construction contract.

(The combining of maintenance and construction in a construction contract introduces uncertain elements of expense which should not properly be included in the construction cost.)

6. *Classification* — That where feasible the following be provided for: (a) Excavation to be classified; (b) No two kinds of work to be included in a single unit where it is practicable to separate them, and (c) Over-break or slides to be paid for at a proper rate, where the engineer is satisfied that the work is properly handled and that the breaks or slides are not due to the contractor's negligence.

(A comparison of excavation prices between contracts providing for classification and those using a single class indicate that a proper classification which enables accurate estimating, is productive of lower prices, and a separation of the different classes of work into individual units appears to have a similar effect.)

7. *Adjustment of Compensation*—That provision be made for an equitable adjustment of extra expense entailed by: (a) Delays and suspension of work, due to acts or omission of department; (b) Unusual increase or decrease in the original unit quantities; (c) Rejection of materials after once inspected and approved, and (d) Acts of God, and other causes manifestly beyond the contractor's control.

(It frequently becomes necessary for the highway engineer to delay or suspend work through no fault of the construction company, or to take other action which disrupts the procedure and introduces extra cost that cannot be foreseen. It is believed economically unsound for a construction company to assume certain risks.)

8. *Overhaul*—That a reasonable free haul limit, preferably not over 500 ft., be employed and that some standard means of computing overhaul be adopted.

(The great variety of methods in use for computing overhaul and their uncertainty have made it difficult to pre-determine accurately the cost of such hauling.)

9. *Retained Percentage*—That ten per cent be retained on monthly estimates.

(An excessive retained percentage on monthly estimates increases the interest charges of the work; and ten per cent in conjunction with the surety bond or securities is believed to afford ample protection to the state.)

10. *Force Account*—That on force account work the allowance for indirect and overhead expense be set at 10 per cent of the direct labor and upon those amounts and upon the material a ten per cent profit be allowed.

(The settlement of force account work has often been subject to dispute and the use of modern equipment has increased in both the proportion of overhead expense and the difficulty of ascertaining its amount.)

11. *Stock Piling*—That, under conditions satisfactory to the department, payment for material delivered be included in monthly estimates.

(The transportation system of the country is unable to serve adequately the needs of highway construction during certain months, thus making it advisable to stock pile materials, but many responsible companies are prevented from financing stocks of sufficient quantity.)

12. *Arbitration*—That limited arbitration, which will reserve final decision to the engineer in all matters pertaining to prosecution of the work, but will provide for settlement of claims for compensation, be included in construction contracts.

(The settlement of controversy under highway contracts by arbitration has shown that not only the number of disputes and court actions is reduced, but that the arbitration itself is seldom resorted to; and that the engineers' hand is thereby strengthened.)

13. *Administration* — (a) That contracts be promptly awarded and certified checks returned within a specified time where possible; (b) That written orders be given by the Department for all important instructions and especially instructions to suspend or shut down the work, the latter to state reasons of suspending or shutting down; (c) That unless a plan for prosecution of the work is given at the time of sending out proposals, the contractor be allowed to pursue his own plan except in emergencies and providing his prosecution of the work is satisfactory; (d) That inspection of materials be made at the source when practicable and at least before unloading from cars; (e) That the departments discontinue publication of the monetary amount of estimates in advance of the letting of work, and (f) That every effort should be made to secure the highest possible type of inspectors and field engineers.

14. *Day Labor Construction* — That true and accurate cost accounting, showing overhead and indirect expense, be required on all construction work performed by state or county forces, an exception to be made only on miscellaneous work not properly designated as construction.

(It is to the public interest to know the true cost of any public work that the department or other agencies of the state may be called upon to perform by day labor.)

15. *Legislation*—That an effort be made to modify existing laws in conflict with those recommendations.

Methods

Indicating the character of its past activities and the work contemplated the committee on methods lists the following:

1. That the Association continue its co-operative work with other associations in formulating standards and simplifying dimensions in the field of materials and equipment production.

2. That the contact formed with equipment manufacturers during the past year be strengthened, and that the joint work of these agencies be extended to all subjects of mutual interest.

3. That a meeting be arranged with officials of the income tax unit to establish rational values for the depreciation of construction equipment, and to provide contractors with information to assist them in properly making out their returns.

4. That the Association continue to improve safety measures in the construction industry and co-operate with the National Safety Council in its investigation and presentation of improved safety methods and devices.

5. That the Association join with other associations of engineers, architects and manufacturers to further the study of seasonal fluctuations in industry and devise means, as far as possible, for their elimination in both the basic industries of construction and in other lines of production.

Commenting on waste from seasonal construction the committee points out that it is recognized that one of the most fruitful sources of waste in the construction industry is due to seasonal let-down. Organizations are disrupted, men leave the building trades for other work, and new ones must be trained at the beginning of the next construction season. This applies not only to building work but to many types of engineering or public work construction. It is the duty of contractors in co-operation with engineers and those in other industries to remove as far as possible the unnecessary peak. The committee proposes to push its investigation of this subject and seek, in conjunction with other industries during the present year, to find the necessary means for making these industries continuous.

In response to many requests from construction companies who have not yet "found themselves" in the field of estimating and cost accounting, the committee

has undertaken to draw up a set of standard estimating sheets which will serve a three-fold purpose as follows:

1. An estimating check memorandum which will give the estimators something to check against, as a precaution against omitting any items of cost from the estimate.
2. Convenient means of tabulating the different quantities and building up the unit cost.
3. A basis for a cost accounting system.

Two of the sheets have been released, the General Building Summary Sheet and the Job Overhead Summary. Other sheets will be released during the present year.

Legislation and Labor

Announcing its advocacy of a federal department of public works and its support of legislation to reduce tax-exempt securities the committee on legislation takes up particularly new legislation affecting immigration. For such legislation the following fundamental principles are suggested:

1. Immigration should be regulated and selected both in quantity and in quality.
2. No more immigration should be admitted of any nationality than we can wholesomely assimilate and in a reasonable length of time wisely incorporate into our body politic.
3. No more immigration should be admitted than can find steady and useful employment without endangering normal American standards of life, labor and wages.
4. The numerical regulation of immigration should be flexible. When industrial depression sweeps the country, all labor immigration should be promptly stopped. But the doors should again be opened when prosperity returns. It should be possible to take either step without waiting for special Congressional action.
5. The closing and opening of our doors should be scientific. It should be based on assured and accurately compiled facts and statistics from every part of the country.
6. The law should be general. The principles should be applied equally to every nation and people without arbitrary discrimination.
7. The law should be courteous to all. It should be possible, without humiliating any, to exclude completely particular types of immigration which definite experience shows to be difficult to assimilate and absorb.
8. The law should provide for the sending of expert examiners to the lands from which immigration mostly comes —this for the sake of both progressive immigrants and for that of our own land.
9. The law should make possible a wise distribution of new immigration. The flow should be restricted or entirely stopped from given peoples, to already congested areas, and encouraged to go to those parts of America where it is desired.
10. The new immigration policy should be distinctly patriotic. It should favor immigration from peoples easily assimilated and check it from other lands. It should guarantee equal treatment and a square deal to all aliens now in the United States. It should provide for higher standards for naturalization and then grant the privileges of citizenship to all who qualify. It should look to the creation of a substantially homogeneous people having a common mind and a wholesomely functioning democracy.

Naming restricted immigration as the principal reason for labor shortage the committee on Labor emphasized lack of apprentices as a secondary cause. The report says:

The situation resolves itself into two problems, the first to provide, as quickly as possible, mechanics to supply the present shortage. The second to provide means for the education of mechanics in lieu of the present apprenticeship system. To assist in solving the first problem, we recommend:

(a) That men now engaged on construction work as building laborers and otherwise, who show an aptitude, be employed as helpers to the skilled mechanics, be permitted to do any work their experience warrants. In a short time they could execute much of the plain work, releasing the older and more skillful mechanics for the most intricate work. (b) That there be established by employers, under their control, special trade schools where the age limit and scholastic requirements be waived, and the only conditions for entrance be an aptitude for and a willingness to learn a good trade. These schools should teach merely the handling of tools and the rudiments of the trade, leaving skill and efficiency to be acquired on the job, where experience has shown it is most successfully acquired.

The second problem is to provide means to insure a supply of mechanics to care for the normal growth of the Nation. To do this all building trade organizations and persons interested in the construction business, should inaugurate a campaign to attract young men to the trade; showing how interesting, profitable and honorable mechanical vocations are.

Chemical Warfare Service to Help in Marine Piling Study

THE Committee on Marine Piling Investigations of the National Research Council announces that it is to have some assistance in its study from the Chemical Warfare Service of the Army. The Bureau of Yards and Docks of the Navy Department, the Engineer Corps and the Quartermaster Corps of the War Department, and the Department of Commerce are placing funds at the disposal of the Chemical Warfare Service for investigations upon substances which are poisonous or repellent to marine wood boring animals and also upon the ways in which these poisons are effective. C. H. Huston, assistant secretary of the Department of Commerce, has been designated by the President as government representative on the Committee on Marine Piling Investigations in order to assist in arranging for the co-operation which these several government bureaus can contribute toward these investigations.

The investigations, themselves, will be designed to determine the relative toxicity of creosotes, commonly used for timber preservation, upon the species of shipworms and also upon the limnoria or gribble. There are also several other groups of substances which are highly toxic to most animals and with which it may prove to be possible to impregnate timber with sufficient permanency to persist for a long period of years. Some of these may be found to be even more potent in protecting timber and cheaper to use than creosote.

The points of attack in these experiments will be two: (1) to find the best substances for impregnating timber which will be poisonous to shipworms after they have entered the wood, and (2) to find substances which will prevent shipworm larvae, as they float about in the water, from settling upon the timber, by altering the nature of the surface of the wood so as not to attract the larvae to settle on it in the definite way in which fresh timber seems to attract them. It may be that different groups of substances may be found for meeting these two purposes, and that the latter method will prove to be the more practicable for protecting timber, provided the wood can be impregnated deeply enough to always present an inhospitable surface no matter how much the timber may be injured by bruising. It is also not impossible that means may be found for poisoning the water in the vicinity of wharves so as to kill off the larvae during the breeding season without seriously injuring the fishing and oyster interests of adjacent localities. Such a method, if found, would be of enor-

mous value in the saving of structures built of unprotected timber which might be unexpectedly attacked by wood boring animals.

These investigations will be wholly under the direction of the Chemical Warfare Service, but they represent a distinct chapter in the plan of investigations of the National Research Council's Committee on Marine Piling investigations and will be carefully co-ordinated with the other work of that Committee.

Comparative Deflection Tests Favor Motor Stages

Pavement Deflections Observed on Test Road Under Truck, Touring Car and Stage—Static Moving and Impact Tests

A SERIES of tests was carried out at the Pittsburg test road in California to determine the comparative amount of pavement deflection caused by several types of vehicles. Particular attention was given to the comparison of the ordinary touring car, the typical motor stage with a load of fifteen passengers, and a solid-tired truck with exactly the same total weight as the loaded stage and also the same distribution of weight on front and rear wheels.

The accompanying series of curves in which the results are depicted graphically show that the deflections caused by the truck range up to a maximum of more than twice those caused by a stage of exactly the same weight. Quite unexpectedly the tests also showed that the use of air-pressure shock absorbers materially increased the pavement deflections when making the impact test.

Pavement deflections were read by the use of rods whose tops were embedded in the concrete pavement and whose lower ends extended down into tunnels

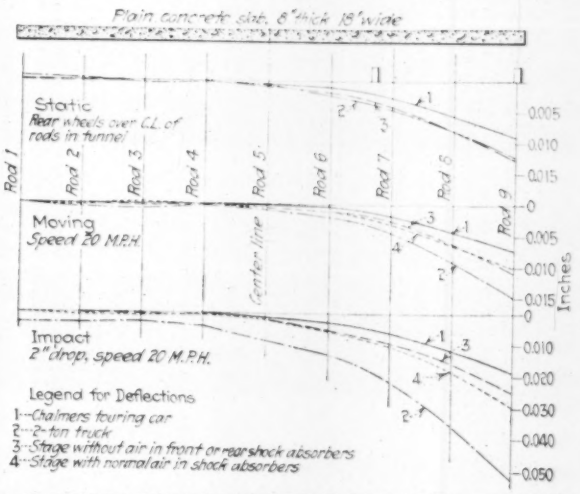
WEIGHTS AND DIMENSIONS OF VEHICLES USED IN COMPARATIVE TESTS

Vehicle	Total Weight (Pounds)	Weight on Front Wheels (Pounds)	Weight on Rear Wheels (Pounds)	Length Wheel Base	Width Tread	Tires
Chalmers Touring Car	5,530	2,070	3,460	11 ft.-1½ in.	4 ft.-8 in.	Pneumatic
Two-ton truck	8,740	3,700	5,040	13 ft.-8 in.	5 ft.-7 in.	Solid
Anchor Stage Line Bus	8,740	3,700	5,040	16 ft.-8 in.	4 ft.-8½ in.	Pneumatic

beneath the roadway where movements of the rods were read accurately by means of micrometer gages. A detailed description of methods of making tests on this road was published in *Engineering News-Record*, Dec. 29, 1921, p. 1048. In the issue of June 29, 1922, p. 1066, there appeared an extended report on the effect of heavy traffic on the concrete pavement.

Attention was first directed to the effect of shock absorbers when stages of the same weight distribution and differing only in the use of shock absorbers showed different deflections in the impact test. To eliminate any differences that might be due to the individual cars, tests were then run using the same car several times successively with and without air pressure in the cylinders of the shock absorbers. These comparisons were made in several runs, in addition to those shown in the accompanying diagrams, always with the result that greater deflections were recorded when the shock absorbers were in use.

The method of making the impact test was to lay across the pavement a plank 2 in. thick and to vary its distance from the deflection rods until positions were found where vehicles passing over this obstruction and dropping to the pavement again gave a maximum rod



THE CURVES SHOW DEFLECTION OF PAVEMENT UNDER IMPACT AND FOR STATIC AND MOVING LOAD

Deflections for three vehicles are shown comparatively in each of the three tests. In the impact curves note that shock absorbers increased pavement deflection.

reading for each of the several speeds at which deflections were to be recorded. The edge of the plank presented to the approaching vehicles was beveled off to a feather edge to allow the vehicle to rise up on it easily. In all records shown in the accompanying curves, the wheels on one side of the vehicles were kept over rod No. 9, nearest the edge of the pavement.

The curves shown herewith are typical of the several runs made and were selected to show, in a general way, the materially greater deflection of the concrete under the impact of a truck, even though its total weight and weight distribution were identical with the motor stage. The truck used was a standard 2-ton type with wheelbase, tire and spring equipment typical of trucks in this class.

The work at the Pittsburg test highway was carried out under the joint direction of the U. S. Bureau of Public Roads and the California State Highway Commission with Lloyd Aldrich and John B. Leonard in charge of all tests.

Indiana 1922 Road Construction Mileage

During 1922 the Indiana State Highway Commission contracted for 110.78 miles of concrete road and 7.07 miles of brick pavement according to Carl Gray, chief engineer. Of this mileage there was completed up to the close of the fiscal year, Sept. 30, 63.43 miles of concrete and 3.52 miles of base for brick and 0.17 miles of brick pavement. Carried over from 1921 were contracts for 17.02 miles of concrete and 34.64 miles of grading and structure work. The commission desires to contract for 160 miles of hard pavement in 1923, approximately one-third of which has already been let. In its contracts the commission insists on storage of considerable material before starting work for the purpose of continuing operations in case of railroad congestion.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Steam Shovel Cuts Snow Removal Cost

By C. C. Kilby
General Contractor, Hartford, Conn.

ONE steam shovel and three five-ton trucks have been found in Hartford, Conn., to be capable of moving approximately the same amount of snow as can be handled by fifty men and ten teams. This means that the city of Hartford recently effected a saving of

STEAM SHOVEL USED IN HARTFORD SNOW REMOVAL
By the use of steam shovels the city of Hartford was able to effect a saving of $138 per day in snow removal over hand shoveling previously resorted to.

$138 a day in snow-removal work by the use of mechanical methods over hand means previously resorted to.

The cost distribution is made as follows:

50 men at $3.50	$175
10 teams at $9	90
Total	$265
Steam shovel	45
Three trucks at $25 each	75
Two pit men at $3.50	7
Total	$127

The steam shovel cost includes coal and crew.

The steam shovels used were ¾-yd. machines on caterpillar type traction, with 16-ft. booms, 14-ft. dipper handles and boom hoists for controlling the booms.

Use of the shovels was resorted to after a heavy snow storm which culminated in a 6-in. fall of hail, seriously blocking street traffic in Hartford the week ending Dec. 30. Vigorous measures were decided upon to clear the streets. Snow plows had been used both by the city and the Connecticut Co. on the principal arteries of travel, but these left two deep, wide windrows of snow and ice piled up from 4 to 6 ft. high on each side of the trolley tracks.

A test run was made to determine whether a steam shovel could handle the frozen material, particularly the slippery sheet of ice which coated the pavement. Records in the office of the writer who was the contractor on the work show that it takes an average of five minutes to load a five-ton truck by steam shovel. The trucks were equipped with side-boards and the snow was compacted with the dipper, so that approximately 8 cu. yd. were loaded on each truck.

It was also found that steam shovels removed the heavy cake of ice which incrusted the pavement beneath the piles of snow, no hand picking being required. Another interesting observation was that the work of the steam shovels seemed to increase the morale of the hand shovelers employed on the streets elsewhere.

A Reinforced Encased Tile Culvert

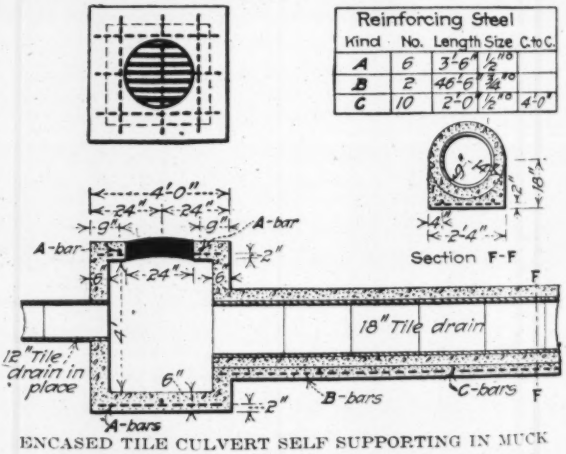
By Paul L. Fetherston
Resident Engineer, Michigan State Highway Department

NEARLY all failures in highway culverts occur when the structure is placed on an unstable soil such as muck or quicksand, without any special precaution being taken to insure success.

The catchbasin and encased tile shown in the sketch were designed to be self supporting in muck and have proved to be so after being in place a season.

Several pipe and tile culverts had failed at this location in years past because of uneven settlement, and so when the road was taken over as a federal-aid project this structure was placed.

Section F-F shows the footing in detail. It is reinforced with ⅜-in. longitudinal bars and ½-in. transverse



ENCASED TILE CULVERT SELF SUPPORTING IN MUCK

bars which are spaced as indicated. This footing carries a standard 18-in. encased tile. The regular encasing and the footing are poured as a unit so that there is no construction line between them.

As indicated in the sketch, the surface water and that from a 12-in. land drain is collected in the catchbasin and discharged across the road into an 18-in. drain.

In placing the culvert the excavation was carried to a depth of 6 in. below that required for the concrete and tile, and then backfilled with gravel which was tamped into place. This was done to prevent the muck from mixing with the concrete when poured.

Welded Steel Tower Built in a Cave

By Howard L. McLean
Stockton, Calif.

TWO hundred feet underground, in a cave near Vallecita, Calif., a 100-ft. spiral steel stairway electrically welded throughout has recently been completed. The stairway is surrounded and supported on the outside by a lattice tower 6 ft. 10 in. in diameter. The core of the structure and the inner support for the stairs is a 10-in. pipe. Due to the narrowness of the entrance passageway this pipe and all the other material had to be taken into the cave in lengths of less than 20 ft.

A small shelflike opening or ledge in the wall of the main chamber of the cave marks the end of the entrance passageway. Here, a hundred feet above the floor, the construction of the tower started. First a reinforced concrete landing platform was laid, enclosed for safety's sake with a steel railing. Two 10-in. I-beams extended from this platform to a point 8 ft. from the ledge, where the tower was to start. These beams served as the anchoring points for four ¾-in. plow steel cables.

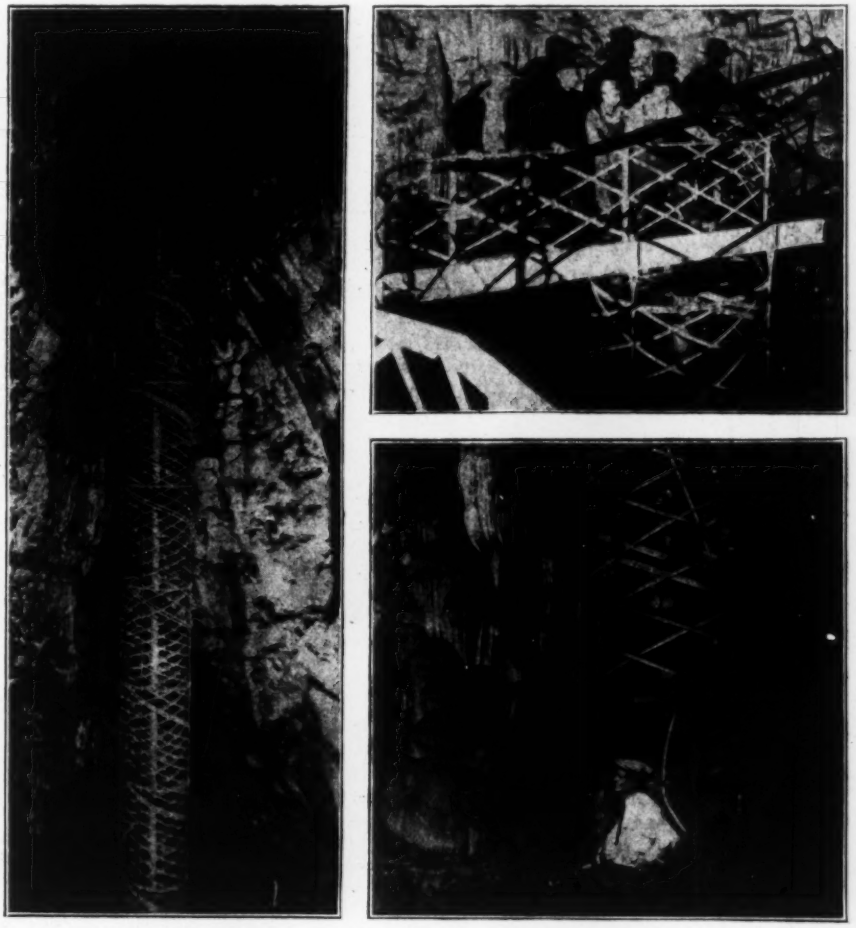
A small electric hoist served to raise and lower men and materials from this point.

Ten steel rings ⅜-in.x2-in. with four short pieces of ¾-in. pipe 5 in. long welded on the circumference, were threaded on the cables. The rings were spaced ten feet apart and held in place by pouring babbitt into the pipes around the cable. The lower ends of the cables were anchored in a block of concrete in the cave floor. Turnbuckles, at the point of anchorage, made it possible to tighten the cables.

The basket work of the tower was built up from the bottom in 10-ft. sections. To place the 2x½-in. Armco iron bars in their spiral position for welding, a cylindrical frame was used. This frame looked like a straight-sided barrel with every other stave knocked out. Two men bent the bars to the spirals marked off on the inside of the frame. Each bar made one complete turn in 10 ft., crossing the other bars at 1-ft. intervals. As each 10-ft. section was completed the frame was raised and hooked over the next horizontal ring.

To form an outer support for the 150 steps, one double spiral of 2x¾-in. iron was put in the basket work. The inner end of the step was welded to the core of the tower. A Z-shaped templet, placed on the step last welded in position, insured the proper rise and spacing of the next one. The steps are 14 in. wide at the outer edge and 8 in. at the inner. When the tower was completed it was given a coat of marine enamel.

The tower is very compact in structure. The central pipe is mainly the inner support for the stairs, but also serves as a ventilating pipe and conduit for the electric light wires. Around the central pipe is a spiral handrail. This is also used as a drainpipe to carry away the seepage water from the concrete landing platform.



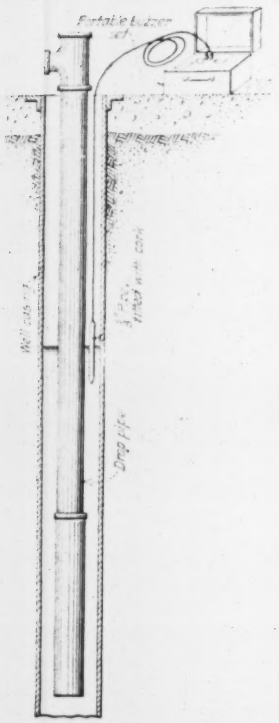
STAIR TOWER 100 FEET HIGH BUILT IN A CAVE
Pipe core, steps and spiral-strip enclosure electrically welded together. Left—Completed tower. Upper right—Landing at top of tower. Lower right—Foot of tower.

Indirect lighting was a feature during work on the tower. Five 300-watt lamps, equipped with reflectors, which directed the light against the white walls of the cave, gave an excellent illumination.

This welded type of tower was adopted as a result of competitive bids received by the owners of the cave for a tower and stairway. A bid of $12,000 was submitted for a structural steel tower 12 ft. square at the base and having a stairway winding around the outside. The estimated weight of this bolted structure was 27,000 lb. The bid for the welded tower and stairway which has been described was $3,000. The weight of steel used in its construction was 6,150 lb. A. H. Tangemann, a welding engineer of Stockton, is responsible for the design and construction of the tower and stairway.

Measuring Well Water Depth

By Charles Brossman
Consulting Engineer, Indianapolis, Ind.



PORTABLE SET FOR WELL WATER MEASURING

A SIMPLE yet accurate means of determining the depth of water in a well is explained in the following paragraphs:

A $\frac{5}{8}$-in. brass tube, perforated at the bottom to allow the water to enter, is inserted in the well. Inside of this tube is a cork float, on the top of which is a metallic cap which makes contact with the two wires leading to the buzzer above. As soon as the tube is immersed in the water the float rises, contact is made and the buzzer signals. By this method one can tell the level of the water at any height and in any test. We have found this very valuable and accurate.

In very many cases electric current is not available and as this outfit used by us is portable, it is very convenient.

Laying Concrete Road in Cold Weather

By Crosby Tappan
Superintendent of Construction, Pennsylvania Highway Department

THE PENNSYLVANIA State Highway Department through its construction bureau, completed last November the concreting of 22½ miles of road between Trout Run and Blossburg, Pennsylvania. Before this date, the temperature had already fallen as low as 19 deg. F., and it was necessary to devise methods of heating concrete materials and protecting the concrete as it was poured, as well as preventing freezing of the subgrade.

The subgrade in advance of the mixer was kept covered by canvas placed over the forms. It was found that this gave sufficient protection to prevent freezing of the subgrade. Flame throwers, burning kerosene, were installed on the mixers and kept burning continually while concreting was going on. The mixing period was lengthened from 1½ to 3 minutes.

As soon as the concrete had been finished, wooden frames covered with heavy canvas were placed over it. Under these shades were hung small oil stoves, which were kept burning until the concrete had set enough to support the weight of straw, when the frames were removed and light canvas strips were laid on the concrete. On the canvas there was placed at once 12 in. of straw. Especial care was taken to see that the outside of the road forms were well covered with straw to prevent freezing of the edges of the concrete. By taking these precautions, the road was finished in a satisfactory manner.

From Job and Office

Hints that Cut Cost and Time

Novel Use of Steam Shovel in Filling Over Box Culverts

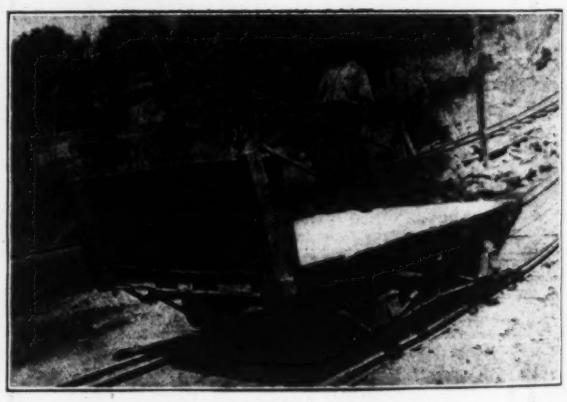
By G. W. McAlpin
Pt. Pleasant, W. Va.

IN FILLING around box culverts a unique method was successfully used during the past season by the Tulley Construction Co. on road work in Mason County, W. Va. Instead of dumping material from wagons at the edge of the fill and shoveling against the sides of the culverts, or using slip scrapers until teams could pass over and dump, a large pile of material was first made near the edge of the culvert. This material was placed as near the edge of the dump as wagons could efficiently work.

The steam shovel was then brought up and proceeded to push this material ahead of it into the hole and against the side of the culvert. Teams were used on other work while the shovel was thus engaged. Material was quickly leveled in this fashion on both sides of the culvert ready for teams to dump.

Unique System Used in Signaling From Material Tram Car

IN ORDER to signal to the hoist house from any point on an inclined tramway used for the transportation of material in the construction of the Pit River power plant No. 1 in California, a unique and efficient method was employed by the Pacific Gas & Electric Co. A signal was sent over a pair of wires by



SIGNAL DEVICE FOR TRAM CAR

bridging them with a signal pole, completing the circuit, and ringing a bell at the hoist house, thereby notifying the engineer. The signal consisted of a 10-ft. pole carrying a hinged metal arm for bridging the two wires, the hinged feature allowing shorting of the circuit regardless of what position the operator might be in. The signal wire was always accessible to the signal man who rode on the tram car.

The tramway paralleled the penstock line and was about 2,000 ft. in length. The car was operated by a cable and electrically driven hoist. It hauled pipe for the penstock, cement and reinforcing materia' etc.

From Job and Office

For Contractor and Engineer

Dragline Used Successfully in Power Canal Deepening

IN WIDENING and deepening the hydraulic canal and forebay for the Cohoes Power & Light Corp., excavating equipment was demanded which could handle wet material, as it was imperative that the hydro-electric plant be kept in operation. After considerable study of the situation D. F. Pelletier, field engineer in charge of the work for the contractors, Sanderson & Porter, decided upon the installation of a 400-ft. span, 1-cu.yd. dragline cableway excavator. Most satisfactory results were secured with this plant, it is reported, and during the first month of operation, the cableway excavated 7,200 cu.yd. of earth, all under water. During the next month the plant handled 4,650 cu.yd. of earth and 2,630 cu.yd. of rock, or a total of 7,280 cu.yd. Material excavated ranged from a sticky mixture of clay and loam to shale rock, which was handled with very little blasting. During part of both the months mentioned the cableway was in operation 18 hr. per day.

The excavation was done in connection with the modernization of the hydro-electric plant to furnish power to various industries which have hitherto taken power from the canal by individual plants, in most cases using inefficient waterwheels of obsolete design. The new power house and gate house were completed some time ago. The power house is located at the foot of a cliff, giving penstocks a vertical drop of 100 ft. to turbines. Penstocks are 11 ft. in diameter and 190 ft. long.

Almost 100 years ago the first Cohoes company was organized, obtaining control of all water-power rights on the Mohawk River, just above the point where it enters the Hudson. A dam was put in a short distance above Cohoes Falls and after several replacements the present masonry dam, 1,443 ft. in length, was built in 1865. From this dam, located about a mile above the power house, the canal leads to the forebay and gate house. Head gates are provided at the entrance of the canal, and a spillway below to regulate the canal level.

The photograph herewith reproduced shows the cableway spanning the 300-ft. width of the channel and delivering spoil to a hopper on top of the cliff overlooking the river and power house. From the hopper the material was sluiced to the river bank and graded to make a fill adjacent to the power house. Water for sluicing was raised to the hopper from the canal and forebay by a 6-in. centrifugal pump.

The movable tower at the tail end of the cableway permitted excavating a large fan-shaped area at one set-up. Hence, only a few moves of the mast, hopper, pump, and sluice were required.

According to the engineer for the contractor the estimate of earth-excavation cost was 51c. a cubic yard, and of rock excavation, $1.03 per cubic yard. This rock excavation figure does not include drilling or blasting. Sluicing of material to the spoil bank is included in both costs. The best day's record was 547.5 cu.yd.

The material from which this article has been written was supplied by Sauerman Bros., whose dragline excavating equipment was used.

EXCAVATING UNDER WATER WITH DRAGLINE EQUIPMENT

Cost of Winter Cement Storage for Road Construction

By Walter S. Anderson
J. J. Dunnegan Construction Co., Shenandoah, Iowa

THE State of Illinois now requires that all contracts in 1923 shall have a provision incorporated demanding that 33⅓ per cent of the cement required to complete the contract must be stored. If not so stored a penalty of 15c. per barrel will be exacted, and the amount deducted from the money due the contractor. In other words, the state directs that the cost of storing this amount of cement be included by the contractor in the bid price he submits.

In this connection the experience of the writer's firm at Neponset, Ill., in 1922, where it stored 12,500 bbl. of cement, will be of interest. The special storage building erected was 50 x 120 ft. in plan by 12 ft. high. Roof, walls and floor of No. 2 shiplap were nailed to 2x4-in. studs spaced 3 ft. The roof was covered with one layer of 2-ply roofing paper. Floor boards were laid loose on a 12-in. thickness of cinders and covered with two loose layers of 2-ply roofing. Cement was unloaded

at a flat price of 3½c. per barrel by men who had handled our cement all the previous season. Our cost sheets show a total initial cost for the building complete of $1,180 and with a salvage value of $600, leaving a net cost of $1,210, which gives the following cost per barrel:

Building (approx.)	$0.10
Unloading	0.035
Insurance, damaged cement, interest	0.015
Total	0.15

For storing smaller quantities the unit cost would increase while for larger quantities it would be correspondingly less. In our judgment the cost of rehandling the cement is not appreciably greater than handling the cement from cars direct. Everything considered, the price of 15c. per barrel established by the State of Illinois is reasonable and fair under present conditions.

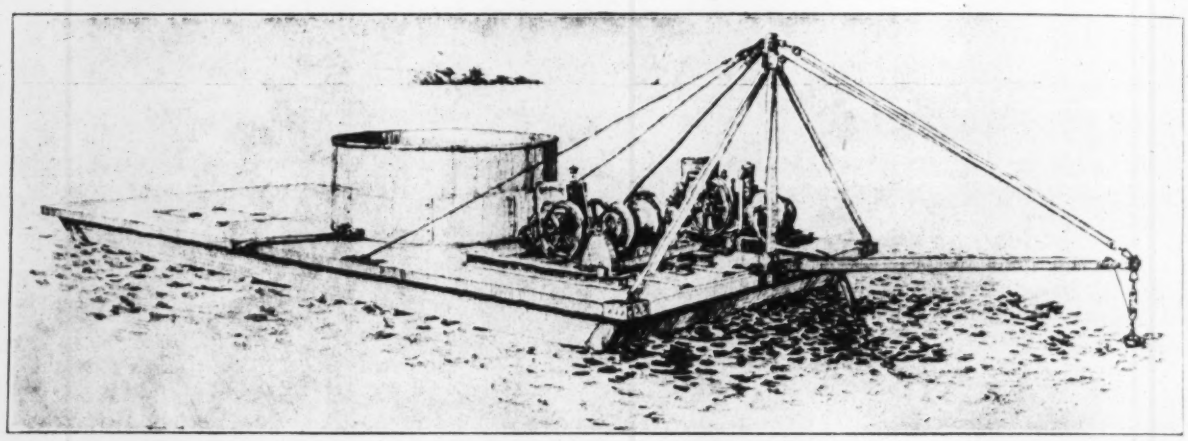
From Job and Office

Hints that Cut Cost and Time

Reclaiming Surface Oil From Baltimore Harbor

By N. C. McLoud
Baltimore, Maryland

MUNICIPAL and port authorities have taken keen interest in an outfit for the removal, by suction, of surface oil from the water in Baltimore harbor. The apparatus was devised by Bancroft Hill, Baltimore harbor engineer and president of the Harbor Board, and was built in the city's workshops.



SUCTION-SKIMMER REMOVES SURFACE OIL FROM WATER

The salient features are a pump mounted on a scow and operated by a small engine. Connected with the pump is a pipe with its mouthpiece submerged an inch or so in the water. The mouth is held in place by a chain suspended from a projecting boom rigidly attached to the bow of the scow.

On board the scow this pipe discharges into a good-sized settling tank, in which the oil and water taken up by the pipe are allowed to settle and separate, after which the water is drawn off through a discharge pipe at the side of the tank. The oil is then burned or stored in barrels. The tank is portable and may be taken ashore.

The pump-scow has its fixed station and responds, like a fire-boat, to calls made by the inspector who patrols the harbor in search of surface oil.

Harbor Engineer Hill makes the statement that one large shipyard disposes of waste oil estimated by the yard's superintendent at 20,000 bbl. annually. Much of the surface oil comes from the tanks of steamers which go to repair yards. This oil is unfit for use because it is full of scale and water and has lost life through the roasting heat of the steam coils used to heat the oil to make it flow.

The presence of oil from this and other sources causes a serious fire menace and its removal is highly desirable. Many port authorities believe that Baltimore has solved the problem.

Cost of Peen-Hammering Concrete Road Surface

By T. M. Ripley
Division Engineer, New York Commission of Highways, Hornell, N. Y.

CONCRETE road surfaces are to be finished, according to the New York State specifications, as follows:

> The surface of the top course shall be tested with a ten (10) foot straight edge laid parallel with the center line of the road upon any portion of the surface, and any depression or other regularity exceeding one-half (½) inch shall be satisfactorily eliminated as directed.

In conforming to these specifications on certain road work in 1922 it was necessary to dress down the pavement at various places over a distance of about 7,000 ft. The places dressed were naturally very irregular in shape but from a close inspection and estimate it was determined that an area equal to 687 sq.yd. was dressed over at a cost of $571.50 which is equal to $0.83 per square yard.

This work was done late in November and early in December, there being one foreman and from three to ten laborers engaged. There was a total of 180 hours foreman and 1,030 hours labor which at the rate of $0.60 per hour for the former and $0.45 per hour for the latter, gives a total cost of $571.50. The work was done by hand; each laborer using a 6-lb. peen hammer.

From Job and Office

For Contractor and Engineer

Device Supports Finishing Machine in Concrete Street Paving

By G. E. Wright

Assistant City Engineer, Gloversville, N. Y.

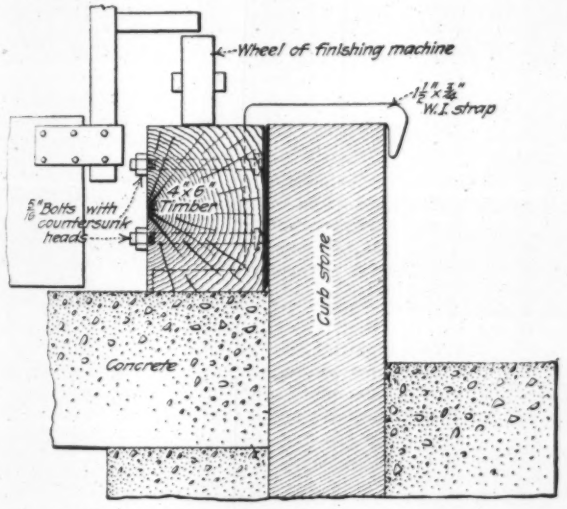
On account of numerous driveways which break the continuity of the curb line, it is impractical to support a heavy finishing machine on curbs in concrete street paving. Every time a driveway is encountered the machine must either be jacked upon a plank and readjusted to grade, or carried on loose planks on top of the curb, both of which methods are unsatisfactory.

To overcome this difficulty the writer devised a method of supporting the machine along the outside of the curb by means of a 4x6-in. timber hooked to the curb by a series of heavy iron straps. The sketch indicates the method employed.

The timbers used usually were 16 ft. long so that driveways could be easily spanned and the concrete paving made a continuous operation. In case the 16-ft. length was insufficient, an extra 5-ft. length was provided.

Inasmuch as the gutters were 6 in. deep, a 4x6-in. timber made the street surface flush with the bottom of the finishing machine supports. Therefore the use of the timbers in no way interfered with pouring the concrete.

The straps were countersunk in the timber and were so spaced that one was placed about a foot from either



TIMBER SUPPORT FOR FINISHING MACHINE

A 4x6-in. timber 16 ft. long is hooked to the curb by a series of iron strap hooks. Finish grade comes flush with the under side of the timber.

end, the two other straps dividing the intervening space into thirds. This spacing of the straps seemed the most desirable to offer the greatest rigidity to the device. The straps were made of ¾-in. x 1½-in. wrought iron or steel stock and were fastened to the timbers with two small bolts with heads countersunk on the curb side. Large wooden screws were tried but because of rough handling these soon pulled out.

On this work, which was done for the city of Gloversville under contract by Morrell Vrooman, Inc., an adjustable gage was used which weighed about 1,000 lb. when set for a 26-ft. roadway.

The work was in direct charge of the writer under H. J. Hanmer, city engineer. The contractor's superintendent was George M. Nagany.

Portable Plant Used in Replacement of Pipe Line Sills and Cradles

The decayed condition of the wooden cradles and sills on the wooden stave pipe line of the Northwestern Electric Co. on the White Salmon River hydro-electric plant in Washington, has made it necessary to replace approximately 1,200 cradles. This pipe line is 13 ft. 6 in. in diameter, 4,987 ft. in length and is supported on wooden cradles set on wooden sills. The wooden sills and lower cradle ties have decayed and are being replaced with wooden cradles on reinforced-concrete sills. As some of the cradles were in worse condition than others, it was necessary to replace them in the order of their respective deterioration.

POURING CONCRETE SILLS FROM TRACK ON PIPE LINE

In order that this might be accomplished economically, it was necessary to provide equipment which could be readily moved from point to point. A concrete mixing plant was located at a central point directly on the pipe line where all material could be supplied by gravity chute from a near-by road. A 24-in. gage track with 4-in. x 4-in. fir rails protected with strap iron was laid on top of the pipe line for its full length. A 3-hp. motorboat engine provides the motive power for the concrete dump car shown in the accompanying illustration. This motor is capable of pulling the two dump cars used on the job at a speed of from 3 miles to 4 miles per hour and in addition handles all cradle material. Two hoppers with "elephant trunks" were constructed for handling the concrete.

The "elephant trunks" were made of sectional iron pipe to conform to the curvature of the pipe line so that the concrete could be placed in the forms without the necessity of hoeing or shoveling. This equipment is provided with removable dolly wheels which can be easily attached and the whole apparatus towed with the gasoline motor from one location to another. Portable forms are used for the concrete sills, which are 18 ft. x 12 in. x 18 in. and are reinforced with steel bars.

An average of eighteen sills per week is poured, which indicates rapid progress considering the occasional long moves.—*Electrical World.*

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

A Word for the Chief with Faith in His Men

Sir—In engineering offices there are two kinds of employers. Did you ever meet them? One expects you to follow the beaten track. He seems to want you to stop thinking except as he directs. No one dares to disagree with him and you avoid asking questions for fear he will tell you not to use your pet stunt for economizing. You feel like saying, "Get off my back." The other drives with a loose rein; says, "Go ahead, and think it out for yourself."

An engineer is not a private soldier. Methods of unquestioning obedience all right for the army don't go in an engineering office, where every one ought to take an *intelligent* interest in the job. Often the man actually doing the designing or planning is in a better position to decide difficult questions than the chief engineer or chief draftsman whose mind is on other jobs; yet the subordinate, if he has a good chief, will often want to ask advice, talk over points, and feel for possible reasons.

A plague on the man over you who withholds reasons, who seems to be keeping something up his sleeve he doesn't choose to tell; until you wonder whether there *is* any reason or whether it is just bluff. Engineering is not poker.

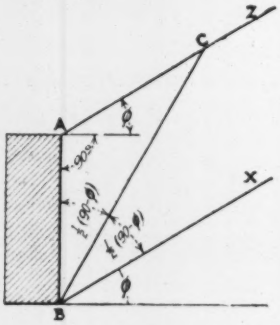
Blessed be the boss who can command respect by his superior judgment, experience, and knowledge, but yet has the grace to say, when he really doesn't know, "You know as much as I do about this; follow your own judgment." For such a one I would work early and late with a happy heart.

SUBORDINATE ENGINEER.

Jan. 24.

Retaining-Wall Pressure With Sloping Surcharge; Inconsistent Formulas

Sir—The discussions of the "equivalent liquid pressure" method of figuring the stresses resulting in bins and retaining walls, in various recent issues by Jacob Feld and Edward Godfrey, were of unusual interest to me. I have questioned the current methods of design and some ten years ago tried to stimulate discussion which might result in more light on the subject, but failed to attain this object.



RETAINING WALL WITH SLOPING SURCHARGE

An interesting point about the sloping-surcharge formula is brought out by the following example: The wall is surcharged with the same material which composes the backfill, in other words it retains a sloping embankment at a certain height. For simplicity we will assume a rectangular section of wall, the inner line being AB, retaining an embankment the surface of which is AZ, forming an angle ϕ, equal to the angle of repose of the material with the horizontal. The line BX from the bottom of the wall is parallel to this top surface. Bisecting the angle ABX we have plane BC forming the angle $\frac{1}{2}(90-\phi)$ with the vertical, while the wedge ABC is a measure of the pressure against the wall AB. In the triangle ABC, the angle at B is $\frac{1}{2}(90-\phi)$, that at A is evidently $90+\phi$, so that the angle at C must be $\frac{1}{2}(90-\phi)$ to result in 180° for the triangle; in other words, the triangle is isosceles with the side AB equal to the side AC. The area of the triangle is $\frac{1}{2} h^2 \cos \phi$, and the weight of this wedge per foot width of wall is $\frac{1}{2} wh^2 \cos \phi$.

On the other hand the standard formula for the total pressure P which a wall would have to resist, in retaining an embankment with sloping surcharge equal to the angle of repose of the material retained, is $\frac{1}{2} wh^2 \cos \phi$, which is identical with the total weight of the wedge to be retained.

This is evidently inconsistent as compared with a non-surcharged wall, in which case the weight of the wedge is $\frac{1}{2} wh^2 \tan \frac{1}{2}(90 - \phi)$, while the pressure is $\frac{1}{2} wh^2 \tan^2 \frac{1}{2}(90 - \phi)$, or somewhere between one-half and six-tenths of the weight of the wedge retained.

There seems to be no reason why the weight of the wedge retained, modified by the factor $\tan \frac{1}{2}(90 - \phi)$, should not be used for figuring the pressure against a wall, with the angle of repose reduced for long sloping surcharges, which tendency is evident on railroad embankments and is usually taken into consideration. Slopes of 1½ to 1 are figured for heights of embankment up to 10 or 15 ft., 1.6 to 1 for heights up to 20 or 25 ft., and 1.7 to 1 above this figure.

We would then, I believe, have some consistent method of figuring retaining wall pressures for various conditions.

M. HIRSCHTHAL,
Concrete Engineer,
Delaware, Lackawanna & Western R.R.

Hoboken, N. J., Jan. 5.

In Defense of Broadcasting

Sir—In your recent editorial on "Broadcasting Practices" you absolved the operations of WJZ from commercialism in broadcasting the discussion on "The Human Factor in Industry" held at the joint meeting of the American Society of Mechanical Engineers and the American Economic Association, but you did not touch upon the motives that lay behind this undertaking. May I be permitted to explain what these motives were?

One of the useful things that radio gives promise of doing is to assist in conveying to the public the plans of engineers for the promotion of social progress. An effective medium between our economic, industrial and scientific leaders and the public at large has always been badly needed. It is notoriously difficult to interest the average man in abstract ideas. He will not attend meetings or lectures; he will not read articles on subjects that do not apply to his own personal and immediate needs; and if the views of engineers are "popularized" in the newspapers, they are apt to be sensationalized and distorted beyond recognition.

Radio, however, appears to offer a solution to this problem, because it can bring facts to hundreds of thousands of people without the slightest physical or intellectual effort on their part. Investigation of A.S.M.E.-A.E.A. broadcasting showed that thousands of listeners were surprised to discover that engineers and economists do not always "crunch dry bones" at their meetings, but sometimes discuss matters of the livest interest in a thoroughly intelligible manner, and that they are actually interested in workmen as human beings and not merely as producers of profits.

For over a century, the effort has been made to educate the American people into a distrust of the expert, a contempt for the intellectual, and a fear of the vested interest. Radio, by presenting the real facts of the case to the public, can do much to counteract such teaching. Surely, no newspaper, however yellow, can convince those who heard the engineers-economists broadcasting that the ideals of the speakers on that occasion are contrary to public welfare. To make clear to the American nation that its true leaders are not the demagogues, but the thinkers and the doers of constructive things, would be a great achievement. Radio is the most satisfactory instrument yet devised for attaining this end.

Of course, not all engineering meetings should be broadcasted. Too many papers are indeed "dry bones" for the majority of people. But wherever possible, meetings concerned with single topics of wide human importance should be given to the world by radio.

W. N. EASTON,
In Charge.
WJZ Radio Broadcasting Station

Newark, N. J., Jan. 10, 1923.

The Ventilation Question Again

Sir—I feel that some reply is necessary to Professor Winslow's letter regarding ventilation, as published in your issue of Dec. 28, p. 1133.

It seems to me that Professor Winslow's letter is quite likely to create the impression that modern ventilating methods are a failure, and that we might just as well step back fifty years or so to window ventilation. The spreading of this impression would be most harmful to the public health.

In the first paragraph Professor Winslow calls attention to the fact that "air conditioning as a factor in building up vital resistance should be emphasized"; then in the second paragraph he shows that the research work done in New York "makes it clear that overheating of occupied rooms is a factor of the first importance in reducing efficiency and increasing respiratory disease"; then, again in the third paragraph, he says that modern ventilation ideas put emphasis on temperature control. All of these points argue against window ventilation The statement that the supplying of 30 cu.ft. of air per minute per person is "positively harmful, since such an excessive air supply tends to overheating, discomfort, and increased respiratory disease" should not be accepted as a fact. It is not at all necessary that the supply of any stated volume of air should tend toward either overheating or discomfort, the elimination of these objections being a simple engineering proposition.

I believe that the majority of people in the construction industries will agree with Mr. Harris that "windows are for light only." Where is there any judgment shown in making windows a given height for lighting purposes, then cutting off part of this at the bottom by the insertion of a board to deflect the air when the window is open?

The use of open windows and gravity exhaust ducts for the removal of vitiated air is entirely dependent upon atmospheric conditions, and it has been thoroughly demonstrated that in systems of this kind, rooms on the leeward side of the building will be found getting air from the corridors and exhausting it through the windows, rather than through the exhaust ducts. This, of course, means they are not getting fresh air. This system will not allow temperature control of air conditioning; the temperature control feature being entirely dependent upon the whims of the occupants of the room, and in the case of a school house, this usually falls to the judgment of the teacher, leaving thirty or forty children to take their ventilation as the teacher sees fit.

Professor Winslow's closing statement must have been written without thought, as the amount of heat required is the same, irrespective of whether the fresh air is forced in by a fan system or is allowed to make its way in through open windows or other openings provided. The only way the gravity system could ever require less heat than a fan system would be if the air supply by the gravity system was not the same as the fan system, and this would be a condemnation of gravity ventilation.

St. Louis, Mo., Jan. 5, 1923. F. J. McMORRAN.

Sir—I trust that I may be permitted space to rebut some of the foregoing criticisms of my letter of Dec. 28.

In the first place I want to make it clear that the New York State Commission on Ventilation found window ventilation alone, without gravity exhaust ducts, most unsatisfactory, so that we would by no means advocate returning to the practice of fifty years ago. Our conclusions as to the adequacy of window ventilation plus the gravity exhaust duct are not based on *a priori* opinion but on the results of four years of intensive experimentation. The statement that "an excessive air supply tends to overheating, discomfort and increased respiratory disease" is a fact and the elimination of these objections is not "a simple engineering proposition." If there is a flow of 30 min.-ft. through a room the face and other exposed parts of the body will be chilled if the temperature of the air is not raised; and if the temperature of the air is raised the clothed portions of the body will be too warm. Furthermore, with a large air flow it is impossible to avoid a uniformity of conditions from moment to moment in different parts of the room that is prejudicial, as our investigations have shown, not only to comfort but to health. Against Mr. McMorran's statement that the system of window ventilation and gravity exhaust will not allow temperature control of air conditioning we must set the results of our exhaustive investigations which show that the conditions maintained by this system are actually substantially superior to those obtained by fan ventilation.

Finally I must dissent from the statement that I was writing "without thought" when I emphasized the financial saving involved in the window inlet and gravity exhaust system. The gravity system requires less heat precisely because it requires less air than the fan system and this is not "a condemnation of gravity ventilation" because a lessened air supply is precisely what is needed for comfort and for health.

The heating and ventilating engineers cannot be held in the least to blame for the unsatisfactory results which have been obtained from their systems. They have faithfully attempted to fulfil the hygienic requirements of an earlier day which called for a large air supply. The physiological studies of the last twenty years have shown that these elder standards were fundamentally in error and the work of the New York State Commission makes it abundantly clear that such an excessive air supply as 30 min.-ft. is uncomfortable, unhealthy and expensive.

New Haven, Conn., Jan. 16. C.-E. A. WINSLOW,
Professor of Public Health,
Yale School of Medicine.

Paint to Prevent Rusting Between Plates

Sir—In an editorial in this journal of Dec. 21, 1922, p. 1,053, attention is drawn to the danger of rust between plates, etc., in bridgework caused in some cases by an insufficient number of rivets. Painting the surfaces prevents rust.

On the heavy Ohio River bridge at Sciotoville, Ohio, Mr. Lindenthal required on such surfaces a red-lead paint containing 40 lb. pigment to a gallon of oil, probably the heaviest paint which had been used for that purpose. Suppose this spread at a rate of 500 square feet per gallon, it would be about 0.003 in. thick, or the total filling is 0.006 in. Is this enough to fill the space left in such places, or would it be better to have two such coats provided? The cost of the paint on these small areas would be inconsiderable. The requirement cited, moreover, represents the best practice; usually the paint is not more than 25 lb. red-lead to the gallon, and if left to the discretion of the shop painters, 18 lb., and the film is not more than two-thirds the above thickness.

I have been told that paint in these places does no good; that when hot rivets are put in the rivet-holes the paint is all burned out. This is not true. In the first place, the pigment, no matter what it is, is incombustible. Second, while true enough that some pungent-smelling smoke comes up from the hot rivet, from the burning of the minute amount of oil in the film when the hot rivet touches it, this burning does not spread far; oil is not injured by a temperature of 600 deg. F., and the mass of metal in the steel plate does not get heated to that temperature, more than a very minute distance from the rivet, so that the destruction of the paint is almost or quite negligible. The smoke of the burning oil may penetrate the crevice and discolor it for a small distance from the rivet-hole, but that is only dirt on the paint-film; it may not look well if it is cut open, but it indicates that there was not enough solidified paint to fill the crevice. It is chiefly the sight of the smoke and its smell which alarms the inspector, and nearly all of this comes from burning off the paint under the flange of the rivet-head, entirely outside the joint; this should always be taken care of by an extra coat on rivets, as has been practiced by some careful engineers for 25 years past.

Moreover, the first field coat ought to be just as good paint as the shop-coat; too often it is not. This whole matter of bridge-painting is entitled to more serious consideration than it often gets. A. H. SABIN.

New York, Jan. 11.

A French Endowed Hydraulic Laboratory

Sir—*Engineering News-Record* of June 24 and of July 8, 1920, contained articles of interest to the advocates of an endowed hydraulic laboratory in the U. S.; a laboratory intended to do work in practical hydraulics, after the manner in which that kind of work is done in astronomy, in endowed astronomical observatories. Quite recently, John R. Freeman, then President of the American Society of Civil Engineers, and others advocated before a Sub-Committee of the U. S. Senate the establishment of such hydraulic laboratory by the government, for the uses and in support of the several governmental departments. As a further news item, and record of world progress made in this line, it may be noted that the "Société Hydrotechnique de France" has been constituted at Grenoble, largely, or mainly, by the efforts of Augustin Blanchet of Rives, Isère, a paper manufacturer, on the same spot where his forebears have toiled these 300 years, originally as iron-masters. In November last, the laboratory of the Société was inaugurated in the presence of members of the French government, and of many engineers and others.

An account of the banquet and speeches made there, would indicate that this "beautiful scientific and industrial initiative" bids fair to make many valuable contributions to our common knowledge of practical hydraulics.

New York City, Jan. 29, 1923. CLEMENS HERSCHEL.

What the Sales Engineer Does

Sir—The letter from A. W. Bedell and the editorial that appeared in *Engineering News-Record* of Dec. 28, 1922, are interesting. What do most of the so-called sales engineers actually do? This question appears in the editorial. Speaking from three years experience, as a sales engineer, I would say a sales engineer gives advice to engineers and sells materials, although in some cases as stated in the editorial, he may not have authority to close an order. However, this is not generally the case.

Technical advice is usually given to engineers. No city engineer or even consulting engineer becomes thoroughly acquainted with materials, their manufacture, comparative qualities, adaptability for various uses, length of life, etc., as a sales engineer in his particular line. It is never good policy for a real sales engineer to give advice to a man not in the engineering profession. If he does, he antagonizes the engineer with whom he interferes and as the majority of materials are sold through engineers, the man interested in sales is cutting his own throat.

Besides giving advice, the sales engineer, in collaboration with practicing engineers, actually designs. During the past year in the office of the firm with whom I am associated, we have designed one water-works pumping station, changed details of design on one rapid sand purification plant, designed one complete distributing system and five extensions to various water-works systems as well as a number of small siphons and layouts for pressure regulating and Venturi meter installations. Remuneration for such designs in every case has gone to the practicing engineer and in some instances the firm the writer represents has not received the order for materials. But in every case we have acquired the good will of the customer—a valuable asset only to be purchased with good service.

The sales engineer actually acts as a consulting engineer, in his particular line, to other engineers. He is a specialist. His recommendations are based on intimate and confidential knowledge of materials that is not even available, sometimes, to a practicing engineer. The ethics of the profession are still with an engineer after he becomes interested in the commercial end of the game. We have recommended a number of times, materials for certain uses or locations carried by our competitors, and the competitors, most of whom are sales engineers, often return the compliment. If you advise a customer to buy an article which does not suit his needs he will find it out and his good will is lost.

There are not many sales engineers who have not had an engineering education and training. When attending public lettings it is very noticeable that many representatives of the firms bidding either on material or labor are members of the American Society of Civil Engineers. The requirements for this are very well known. Engineers representing various materials are chosen on account of their actual experience as an engineer with these materials. They are not selected on account of their ability as salesmen, which is often very questionable.

As to credit given by engineering societies for the work of sales engineers, it varies as much as with the practicing engineer—some design, some supervise construction after the goods are sold, and a few do very little but sell. As to the name, if the profession desires that it be changed, little actual opposition would be met. Personally, I should not like to be counted out of the profession entirely, for I do as much engineering work now as I ever did. To the engineer who has entered the commercial world, certainly should be given some title properly cognizant of his training and standing as an engineer. The word "engineer" has certainly been mistreated, and if we sales engineers must protect it, I, for one, will co-operate, as will the firm by whom I am employed. My title was not suggested by the firm, but was my own choice.

C. E. PAINTER,
Sales Engineer, D. C. Dunbar Co.
Salt Lake City, Utah, Jan. 9.

Brick Paving in the City of Panama

Sir—In 1906, the writer was in charge of the paving of the streets of the City of Panama subsequent to their upheaval by the introduction of water mains and sewers.

Trenching in the narrow streets had destroyed the old cobble pavements on a heretofore solid foundation of natural hard clay and the entire built-up section of the city comprising some 5½ miles of street was repaved with vitrified brick, using a concrete foundation except in the regions of lightest traffic. Pavements, varying from 15 ft. to 30 ft. in width, were given a fairly high crown on account of the heavy rainfall, and were laid between concrete curbs. The joints were filled with grout.

In all, about 65,000 sq.yd. were laid in the city in 1906 and 1907. On the completion of this work, the writer removed to other regions and did not again see Panama until recently, after a lapse of 15 years. It was a matter of considerable interest to note the present good condition of the original brick pavements which have had a long and severe service test.

Practically all of the original pavements were found in place except for a few changes due to street openings or widenings and the building of a tram-way in the main street.

It should be noted that these pavements were designed for a traffic of horse-drawn vehicles only. After their completion, the first automobile was brought to the Isthmus in the shape of a privately owned, French-built touring car. The use of motor vehicles for commercial purposes had not been thought of when the pavements were designed. Today, however, and for some years past, the city of Panama has had heavy motor truck traffic, including that to and from the nearby army posts.

On the heaviest traffic streets there was some wear of the brick noticeable, and some maintenance had been required. Elsewhere the original brick pavements showed little wear considering their age and the changed conditions.

Brick was originally selected because it was thought that it would prove satisfactory under the contrasting conditions of the torrential rains one half the year and the heat of the other half. It was also a consideration to obtain a material that could be quickly laid without a complicated plant or specially skilled labor. In 1906 labor was scarce and when the work started, the writer had less than half a dozen men who had ever seen a pavement laid. The bulk of the work was done by unskilled Jamaicans who soon acquired ability and speed.

That materials and workmanship were good and a suitable type selected is apparent from the service given for a period which is entirely adequate considering the changed conditions.

HENRY WELLES DURHAM.
New York, Jan. 5, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

There has been introduced into the New York State Senate a bill calling for the appropriation of $5,000,000 for the construction of an administration building on state land west of the Capitol building, in Albany.

A number of research scholarships in highway engineering have been established at Iowa State College for the summer session of 1923. These are available to students who are qualified to assist in the regular research work of the Engineering Experiment Station.

Tuesday, February 13, has been set as the date for a joint legislative hearing in the New York legislature on the state fund bill of the Lockwood Housing Committee; the bill regulating the disposition of stock investments of insurance companies; the bill creating a trade and commerce commission and the measure regulating trade unions.

Proposed electrification of the Grand Trunk lines between Niagara Falls and Toronto and eastward of Toronto will be studied by a board of technical experts who will be appointed to inquire into its feasibility, according to an announcement by Sir Henry Thornton, president of the Canadian National Railways.

Three more generators have been ordered for the Chippawa-Queenston hydro-electric power development, the purchase having been approved by the Provincial Government. Four generators are now in operation and a fifth is being installed. The additional three will give the power house at Queenston a total capacity of between 400,000 and 480,000 hp.

The Senate on Jan. 25 passed a resolution by Senator McCormick, of Illinois, providing for the appointment of a senatorial commission to investigate the problem of a 9-ft. channel in the waterway from the Great Lakes to the Gulf of Mexico. The resolution specifies that three members of the committee are to be Republicans, and two Democrats.

Senator Alexander Simpson has introduced a bill in the New Jersey Legislature for a referendum election to repeal the $40,000,000 bond issue law adopted by the voters November last. The bill proposes that the question be submitted to the voters at the November election this year. Another bill will be offered by Senator Simpson in the event that the first is killed. The second will provide that funds for road construction shall not be expended except when specifically appropriated by the legislature.

A. G. C. Completes Successful Convention

Lost Time in Construction, War-Fraud Suits and Indictments Furnish Discussion—Dues System Revised

Engineering News-Record Staff Report

CONSIDERATION of methods whereby lost time in construction could be eliminated; reaffirmation, by resolution, of confidence in the form of contract under which war-time construction was prosecuted, and an appeal in the same resolution for the public to withhold judgment of war-fraud suits and indictments until trials had been disposed of; discussion of problems affecting particular divisions of the industry; and a decision to abolish the present dues system, were the high spots in the last days of the convention of the Associated General Contractors of America, held last week in Los Angeles. A preliminary report of convention proceedings was given in last week's issue in these columns. Abstracts of convention committee reports will be found on pages 260-262.

At Wednesday morning's session in presenting the report of the committee on methods. A. P. Greensfelder, chairman, emphasized the need for increasing the working season and urged each chapter to send in suggestions on the subject. Planning work well in advance and winter discounts would help, he said, as would also the study of methods of continuing work in wet and cold weather, such as the use of caterpillars when wheeled vehicles are no longer effective. He recommended that all members read the series of articles by C. S. Hill in *Engineering News-Record* on "Lost Time in Construction."

How Railroads May Aid

Railroads should be shown the advantage of establishing seasonal rates for construction materials during times of light traffic. This would help the railroads and would facilitate advance planning on construction. Reciprocal demurrage whereby shippers would be compensated for delayed deliveries would be quite as logical as penalizing the shipper for delay in unloading cars. If railroads set the date of delivery when accepting shipments and stated in the manifest the time allowed each division for handling the freight, responsibility for delay could readily be fixed. Because of the high cost of labor turnover the average foreman should not have unlimited authority for arbitrarily discharging workmen. Instead, necessary discipline should be maintained as far as possible by the alternatives of transfer and suspension.

Investment in power equipment is good economy, it was suggested, but each piece of machinery should be entered on the payroll by number, and its cost and earnings should be carefully studied to determine its usefulness. A sample A. G. C. manual was shown which consisted of a loose-leaf binder in which members could file data sheets on equipment, contracts, insurance, labor, etc., as sent out periodically by the association.

In an address on "The Skill Element in the A. G. C. Slogan," E. J. Mehren, Editor, *Engineering News-Record*, pointed out that knowledge of management, methods and the use of equipment constitute a large part of the contractor's stock in trade and require continual study. He supplemented Mr. Greenfelder's suggestions with three more, namely; (1) that local chapters

London Underground Extension Awarded to Foundation Co.

Contract for the extension of the London Underground Ry. from Hendon to Edgware has been awarded to the Foundation Co., New York City. The new line will be about 3 miles long and the contract involves £258,000.

The extension will serve Colindale, Burnt Oak and Edgware at each of which places stations are to be built. It is hoped that the work will be completed by the end of 1923.

New Jersey Bill Would Open Road Specifications

A bill has been introduced in the New Jersey legislature declaring for open specifications for competitive bidding in the expenditure of the $40,000,000 highway bond funds. The keynote of the bill, which was introduced by Senator Mathis, of South Jersey, is found in the fifth paragraph, part of which reads: "It shall be the duty of the board of public body in charge of the (road) work that specifications are so drawn that the competition is in every way fair and reasonable."

House Raises Appropriation for Rivers and Harbors

Washington Correspondence

Action by the House of Representatives increasing the appropriation for river and harbor expenditures by nearly $30,000,000 more than that recommended by the director of the budget has had its influence on the Senate where the prospects are that the $56,589,910, the amount voted by the House, will be approved.

The amount voted by the House was the total of the estimate submitted to the director of the budget by the chief of engineers. The appropriation is subdivided as follows: Principal seacoast harbors, $19,683,410, maintenance, $7,375,400; secondary harbors and coastwise channels, $7,860,900, maintenance, $1,509,600; lake harbors and channels, $1,726,000, maintenance, $1,450,800; principal rivers, $13,726,000, maintenance, $2,249,000; secondary rivers, $181,820, maintenance, $826,980.

endeavor to compile, classify and report to headquarters elements of construction costs; (2) that data be compiled on the proper use of equipment giving particularly the functions and limitations of different types; and (3) that data on the management of labor be compiled to show how to handle labor to best advantage, how to hold it over during slack times, etc.

Quantity Surveys Discussed

Except for a vigorous plea by Alfred Carlson, Seattle, for the proper protection and care of equipment while not in use, much of the discussion at this session referred to quantity surveys. The quantity survey plan to which sixteen Milwaukee contractors subscribe was explained by W. F. Tubesing, who believed that the plan benefits all and hampers none of those who use it. In Milwaukee the central bureau compiles and tabulates quantities on all masonry and concrete work, the intent being to protect members from the danger of error in estimating quantities. This does not obviate the need for each individual contractor to look over personally the work and determine the best layout and construction plan.

At Thursday morning's session of the building division F. J. Twaits, Los Angeles, read a paper on "Architects as General Contractors" in which he defined the function of the architect as showing the owner what to get while the contractor's function is to show him how to get it. Each is a business in itself and the architect who subdivides the work unto a great number of small contracts which he personally supervises virtually becomes a contractor.

The question of admitting to membership men who engage in both designing and contracting was discussed at length and although opposite views were expressed the concensus of opinion favored taking in such members and afterward proposing any necessary changes in policy. The man who has ability in both professions cannot be put out of business and the association would only be weakening itself by refusing him membership. Edward Haupt, Chicago, suggested that perhaps licensing laws would aid in keeping each profession within its proper field. Alfred Carlson, Seattle, pointed out that general contractors who sublet an entire job in small contracts and then fail to keep adequate personal supervision on the work provoke the architect into dividing jobs up into small contracts and supervising these himself to avoid paying a percentage to general contractors.

Birmingham Quantity Survey

Discussion on quantity surveys begun in the previous session was continued with lively interest, although not all were convinced that the plan was economical. J. G. Tidwell described the quantity survey plan used in Birmingham, Alabama. The plan has been in use there for a year, covers all items on each job, and has effectively prevented wide discrepancies in bids. Godfrey Edwards, Los Angeles, suggested that the quantity survey idea might be tried out by any chapter or by a group of members on one job before attempting its more general introduction. Mr. Twaits pointed out that the most could not be expected from quantity surveys unless contractors and the central bureau estimators used the same accounting forms and methods of listing unit quantities.

After vigorous expression of opinion disapproving the indictments and war-fraud suits, the following resolution was adopted by the A. G. C. in Los Angeles last week:

"Whereas, when war was declared in 1917 the unpreparedness of this country developed the necessity of constructing as a precedent to the training of our army and the manufacturing of munitions; and,

"Whereas, it is a fact that the fate of the world was in balance, depending upon the speed with which this country could develop its facilities in men and munitions; and,

"Whereas, as a consequence thereof it was recognized that the utmost speed in construction must be attained; and,

"Whereas, the surest measure of the wisdom of the procedure adopted by the War Department is that it accomplished the result, and the consideration at this time of other plans can only be conjectured; and,

"Whereas, the Department of Justice of the U. S. Government has secured indictments for conspiracy against seven former war officials in connection with construction and has sued 11 general contractors who built 11 of the original cantonments; and,

"Whereas, the bringing of these eleven suits and securing the indictments of the seven former government officials calls for a defence of the construction industry before the bar of public opinion by this body and a request for a suspension of judgment by the public until after the trial of these cases;

"Therefore, be it resolved, that we agree with and reaffirm the approval of the form of contract and procedure of war construction contracts made by the committee of technical experts headed respectively by A. N. Talbot, then president of the American Society of Civil Engineers, and by Francis Blossom, of the firm of Sanderson and Porter, quoting from the latter as follows: 'The board finds that the use of this form of contract as finally developed was well justified and contributed to the success of the emergency program; that by its use speed was obtained in war construction projects; and that it is probable that such work could not have been performed in the time without it or its equivalent;

"Be it further resolved that no act of an individual, no overzealous public official, no propaganda, can dim the pride and honor we have in the men who planned and built the work needed to win the war, and when again our safety and civilization are in danger we will honor and applaud men with the skill, ability and courage to get results in spite of rules, regulations and red tape;

"Be is further resolved that the Associated General Contractors of America in convention assembled in Los Angeles, Calif., demand the immediate trial of all these proceedings: that we look with suspicion at any delay; and that every member of our industry throughout the land should insist and demand through every avenue of influence that may be available to him that the Department of Justice be challenged to prove the charges it has made."

At Thursday afternoon's session the quantity survey discussion was concluded by a motion that the chair appoint a committee of three selected from the advocates of the plan to prepare and submit to the committee on methods details of a quantity survey plan such as seemed most likely to be generally useful to association members, this to be the foundation for later recommendation by the committee on methods. The chair appointed on this committee W. F. Tubesing, Milwaukee, Wis., J. G. Tidwell, Birmingham, Ala., and W. F. Creighton, Nashville, Tenn.

In his discussion on "How to Eliminate the Irresponsible Bidder," W. A. Simpson, Los Angeles, said many bonding companies investigate only the honesty of the financial standing of the contractor before writing his bond, although more failures are caused by lack of judgment and skill than by insufficient resources. Since the law frequently makes it necessary to award to the lowest bidder, one of the prerequisites to eliminating irresponsibles is to get bonding companies to raise the requirements put on contractors. Incidental to the discussion of bonds it was suggested that since owners require a bond from the contractor he in turn might well safeguard his own interests by requiring of the owner a bond guaranteeing payment within thirty days after satisfactory completion of the job.

Irresponsible Bidders

J. C. Edwards, chairman of the building division, suggested that perhaps contractors themselves shared with bonding companies, architects and material men responsibility for the existence of irresponsible bidders by not showing the latter the dangers of improperly figuring costs. Contractors who are unsuccessful because they do not know how to figure costs need education on that score after which they have a chance to get out of the irresponsible class. It would also help in eliminating irresponsibles, it was suggested, if material men could be induced to be more careful about assuming responsibility for such operators.

Officers of the building division elected for 1923 were Col. J. R. Wiggins, Philadelphia, chairman, and W. F. Creighton, Nashville, vice-chairman.

In the first session of the highway division Walter Gillette, Los Angeles, discussed the construction of public works by day labor. Contending that contractors should endeavor to inform the public on the wastefulness of the practice, he believed that the public would put a stop to it if it had the facts. The newspapers need to be informed regarding the high costs of day labor work.

On the subject of contracts W. F. Creighton contrasted the satisfactory relationships in performing the work under the standard contract documents of the American Institute of Architects with the stress and difficulty in working under the usual forms of public works contracts. He urged that there be conferences with engineers and committees of engineering societies to the end that more equitable contracts, as those being worked out by the joint committees of the Associated General Contractors, be adopted.

In the annual report of the highway division H. H. Wilson, the chairman expressed the appreciation of the Asso-

(Continued on p. 277)

George W. Fuller Nominated for President Am. W. W. Assoc.

The nominating committee of the American Water Works Association has submitted the following ticket of officers for 1923-24: President, George W. Fuller, New York City; vice-president, Frank C. Jordan, Indianapolis; treasurer, William W. Brush, New York City; trustees, District No. 2, Charles R. Bettes, Far Rockaway, N. Y.; District No. 5, Edward E. Wall, St. Louis. Under the constitution additional nominations may be made by means of a petition of twenty-five members filed with the secretary up to noon, March 1. If there are no other nominations the officers named by the nominating committee will be declared elected without ballot. The election results will be announced at the 43rd annual convention of the association, which will be held at Detroit, May 21-25.

Knickerbocker Demurrer Denied

Denying the demurrer of the Knickerbocker Theater Co. to damage suits (see p. 226, Feb. 1) on account of the roof collapse of Jan. 28, 1922, the Supreme Court of the District of Columbia on Feb. 2 held that the proprietor of a place of amusement is charged with positive knowledge of its reasonable safety for its purpose.

Gas Plant Wrecked by Purifier Explosion

A gas explosion in the purifier house of the Springfield Gas Light Co., Springfield, Mass., on Feb. 1, wrecked the building and damaged much nearby property. Three men were killed. The cause of the accident has not been finally determined, but it is thought that a leak in one of the purifier boxes allowed gas to accumulate in the building, the explosive mixture finally becoming ignited in an undetermined way.

Tanana River Bridge Completed

Completion of the 700-ft. truss span of the Alaska R.R. across the Tanana River was announced on Jan. 25 by Col. Frederick Mears, chief engineer of the Alaskan Railroad Commission. This is the last important structure on the line. The Metropolis bridge across the Ohio River has the only simple truss span exceeding the Tanana.

Appointment of Single Tennessee Road Commissioner Contested

Two of the three highway commissioners in the state of Tennessee forced out under a reorganization bill passed by the state legislature whereby the state highway department of three members was replaced by a single commissioner of public roads and buildings, have filed an injunction seeking to restrain the single commissioner from taking office. J. G. Creveling, Jr., former county engineer of Davidson County, was recently appointed by Governor Peay as the commissioner of public roads and buildings. The three-man commission was comprised of one commissioner each from the three congressional districts in the state.

The injunction arguments will be given an early hearing before the State Supreme Court at Nashville.

Indianapolis Chamber Recommends Resurfacing Cost Plan

The Committee on Civic Affairs of the Indianapolis Chamber of Commerce, after several months' investigation of methods of financing the resurfacing of improved streets, has adopted a resolution favoring the payment of three-fourths of the cost of resurfacing from the general funds of the city, the other one-fourth to be paid by the owners of the properties. The Committee on Legislation will endeavor to have this resolution put into the Indiana law.

House Moves Toward Amendment to Curb Tax-Exempt Bonds

Washington Correspondence

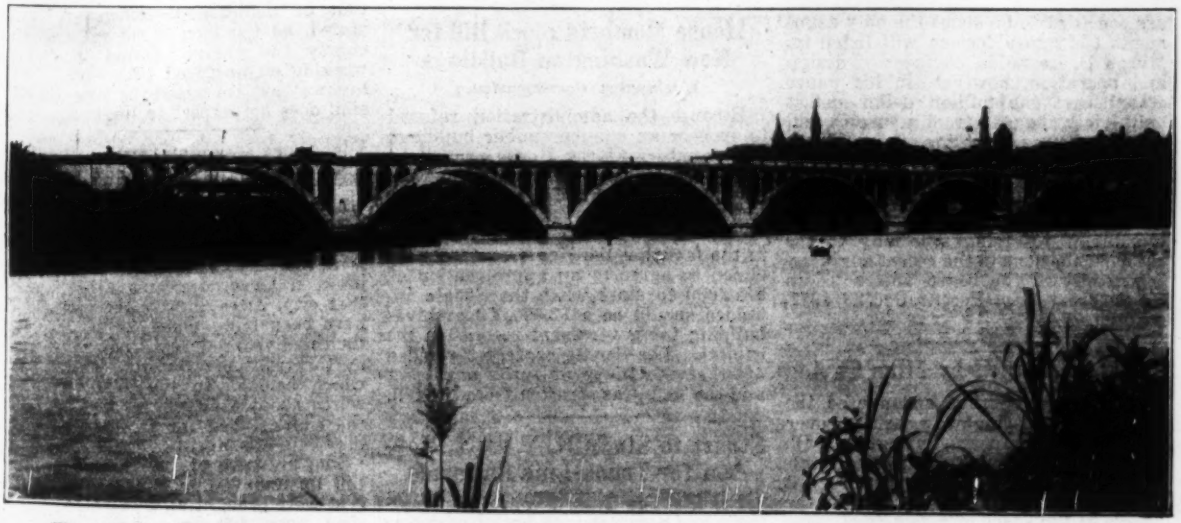
With seven votes to spare, the House of Representatives on Jan. 23, rather unexpectedly, passed the joint resolution proposing an amendment to the constitution of the United States intended to prevent the issuance of tax-exempt securities. The belief is quite general on Capitol Hill that the approval of the joint resolution cannot be secured at this session of Congress in the Senate. This would have the effect of allowing the legislation to die with the session of Congress which ends March 4, thereby making it necessary for the House of Representatives to reconsider the measure at the next session. Even were the Senate to pass it before March 4, many are of the opinion that great difficulty will be experienced in securing the ratification of the amendment by two-thirds of the states.

Tri-State Development of Delaware River Proposed

A plan for the development of the Upper Delaware for water supply and power by the states of New Jersey, Pennsylvania and New York has been incorporated in a bill introduced in the New Jersey Legislature. The plan is proposed by Morris R. Sherrard, consulting engineer to the North Jersey District Water Supply Commission and to the Department of Streets and Public Improvements of Newark. Under the terms of the bill the Governor of New Jersey would appoint a commission of three members, to co-operate with representatives of New York and Pennsylvania in recommending a policy to be followed in the utilization of the waters of the Upper Delaware.

An appropriation of $25,000 for clerical and other necessary expenses of the New Jersey Commission is proposed but the commissioners would sreve without pay.

Reinforced-Concrete Bridge Over Potomac Opened To Traffic



The 2,700-foot Key bridge across the Potomac at Washington was thrown open to traffic on Jan. 17. The bridge was built by the Corps of Engineers of the Army under direct appropriation by Congress. The cost was $2,350,000.

The bridge is constructed of reinforced concrete. Its center is 85 ft. above mean low water. It is 70 ft. wide and carries a double-track electric railway. There are in addition two 16-ft. roadways and two sidewalks each eight feet wide.

The bridge is named for Francis Scott Key, who was born on the site of the District of Columbia approach of the bridge. It replaces the old Aqueduct Bridge, which has been in use for more than three quarters of a century.

Chicago Engineers Hold All-Day Civil Problem Meeting

Engineering problems in the water, sewage and electric utilities of Chicago were covered Feb. 1 in the series of papers presented at the mid-winter all-day convocation of the Western Society of Engineers. The three sessions were well attended, the dinner meeting drawing an audience of nearly 400 engineers to hear Samuel Insull, president of the Commonwealth Edison Co. compare the Chicago electric plants of 30 years ago with those of today and those in contemplation in the immediate future which will utilize steam at 600-lb. per square inch pressure and turbine generating units of 50,000 kw. capacity in the 500,000 kw. station on Crawford Ave.

Harrison P. Eddy, consulting engineer, Boston, Mass., described present-day methods of sewage treatment and outlined the procedure recommended by the Board of Experts reporting on the proposed $13,000,000 Northwest sewage treatment plant of the Sanitary District of Chicago. (See *Engineering News-Record*, page 324, Aug. 24, 1922.) Mr. Eddy was preceded by George C. D. Lenth, secretary of the Clay Products Association, who sketched historically the genesis of the present 40-year sewerage system in the loop district held back from improvement awaiting a solution of the subway problem. Langdon Pearse, sanitary engineer, Sanitary District of Chicago, outlined the present status of the district work.

The water utility problem was handled first by Dabney H. Maury, consulting engineer, who described recent developments at Denver, Colo., Norfolk, Va., and Tulsa, Okla. He stressed the danger of metering without previous proper rate adjustment.

Louis R. Howson's paper on "What Metering Would Do for the Chicago Waterworks" gave a startling and graphic account of the enormous present waste under which but 25 per cent of the consumers get water under satisfactory pressure. This argument and the fact that filtering can never be accomplished until wastes are curtailed are conceded to be about the only arguments Chicago aldermen will listen to. Myron B. Reynolds, engineer of design and operation, however, in his paper stated that the million dollar deficit only lately changed from a surplus will be the starting point for official action.

Clarence Goldsmith, assistant chief engineer, National Board of Fire Underwriters, discussed the waterworks system from the fire protection standpoint referring especially to the recommendations in the recent engineering report of the board abstracted in *Engineering News-Record*, Dec. 28, 1922, p. 1125.

Bridge Damaged by Mine Caving

Pier settlement has endangered the security of a highway bridge over Spring Creek, near Springfield, Ill. Caving of the ground due to local coal-mining operations caused a settlement of 8 to 12 in. of the main pier of the bridge in the space of a few days. One abutment has also settled. Falsework has been placed under the spans of the bridge and jacking is to be done to restore them to proper elevation when the settlement of the substructure stops.

State Water Conservation Measure Advised for Connecticut

A State Water Conservation Commission with broad powers of control over the taking of water for municipal supplies, both as regards quantity and quality, is recommended by the Commission to Investigate the Pollution of Streams created in 1921 by the Connecticut legislature. A notable recommendation of the commission's report is that statutory provision be made for the formation of sanitary districts to include the whole of one or more stream drainage areas. The commission expresses the hope that such a plan would result in co-operation between the various municipalities in each di trict and between these and private interests, and that it would facilitate the financing of the necessary projects for correcting such stream pollution as may exist. An appropriation of $50,000 for the work of the proposed State Conservation Commission in the first two years of its existence is proposed.

Included in the membership of the commission are David M. Saville, manager and chief engineer of the Hartford Water Works, who has been chairman of the commission; and Robert A. Cairns, city engineer of Waterbury.

The recommendations of the commission on pollution, if carried into effect, would provide that separate state agencies, such as the Agricultural Experiment Station, be used for the laboratory and research work of the proposed Water Conservation Commission; that the new commission confer with the State Board of Health in matters of water pollution where both public health and other questions pertaining to a given stream are concerned but that where health only is involved sole jurisdiction should be vested in the State Board of Health; that the proposed commission establish rules and regulations relating to the condition and use of the waters of the state; and that the state courts be given power of injunction to enforce the decisions and regulations of the Water Conservation Commission.

House Members Block Bill for New Washington Buildings

Washington Correspondence

Because the administration refused to sponsor an omnibus public buildings bill, members of the House are blocking efforts to secure appropriations for new government buildings in Washington.

Evidences of this attitude were seen in the fact that the House conferees declined to agree to an appropriation of $250,000 to start what the Senate intended should be a $2,500,000 archives building for government records in the capital. The Senate conferees receded after several days of futile argument and the item was stricken from the bill.

Stuart to Study N. Y. Port Problem for Trunk-Line Railroads

Francis Lee Stuart, consulting engineer, has been retained by a committee of executives of the trunk-line railroads serving New York to investigate and report on transportation conditions in the Port of New York insofar as they affect the railroads individually and collectively.

Robert M. Morton New California State Highway Engineer

Robert M. Morton, whose appointment as state highway engineer of California to succeed the recently resigned A. D. Fletcher was noted in the columns of this journal recently, has had varied experience as highway engineer. During the past two years he has been engaged with San Diego County as chief engineer of improvement involving the expenditure of almost $2,500,000. Prior to that time he was with Sacramento County as chief engineer engaged in the design and construction of a road system of 124 miles. For a short time prior to that he was superintendent of construction of the California Highway Commission assigned to make studies and reports on the selection of state highway routes through Sacramento, San Joaquin, Alameda and Contra Costa Counties.

Mr. Morton was graduated from Washington & Jefferson College in 1906. He was employed immediately thereafter by the Public Road Office of the U. S. Bureau of Agriculture, first as civil engineer student, then as assistant highway engineer. Various assignments placed him on object lesson road construction in states throughout the Middle West, South and Pacific Coast. In 1908 he was assigned to San Joaquin County, California, for the Department and made a study of local highway needs, assisted in construction of an object lesson road and then entered the employ of the San Joaquin County Highway Commission as chief engineer in August, 1909.

California Highway Commission Engineering Force Reduced

The newly appointed California State Highway Commission has announced that material reductions will be made in the number of employees in the engineering department. According to press reports, the reductions will amount to 20 per cent.

This is not to be taken as an indication of decrease in efficiency, it is stated, as the men to be released are chiefly the engineers and draftsmen working on proposed extensions of the highway system which the new commission does not expect to undertake now.

Wreckers Recover Copper Sunk in N. Y. Harbor Three Years Ago

One of the largest bucket digging dredges of the Merritt & Chapman Derrick and Wrecking Co., New York, is anchored in the main ship channel, between Governors and Ellis Islands, that city, salvaging copper bars which have been lying under 93 ft. of water for three years since a lighter was sunk by the transport Buford. The copper, which belongs to the government, is worth about $150,000. Divers searched the channel bed for two years before they could locate it.

The pigs are of two sizes, weighing 140 lb. and 250 lb. respectively. The first were brought up on Jan. 14. Since then over 400 have been recovered. After ingots are hoisted they are washed off at the depot of the wrecking company, then are sent by motor truck to the government warehouse.

It is expected that nearly all the lost copper will be recovered.

A. G. C. Holds Successful Annual Convention

(Concluded from p. 274)

ciated General Contractors at the successful conclusion of the conferences on contract provisions with the American Association of State Highway Officials. The Division by formal vote expressed its thanks to *Engineering News-Record* for the assistance it rendered through editorial discussion in getting results from this co-operative work. Many instances were cited of contractors being driven out of certain states by reason of inequitable contract provisions, South Dakota's case being particularly flagrant in this respect. There was much commendation of the Minnesota law requiring public officials to give publicity to the cost of work done by day labor. Failure to comply with the law is a misdemeanor.

Officers of the highway division elected for 1923 were: Chairman, L. L. Rogers, Los Angeles; vice-chairman, N. F. Helmers, St. Paul.

Public Works Division

One of the interesting matters discussed at the meeting of the public works division was the obligation of the contractor in the interest of his client to urge upon the cement companies that they change their practice and sell wholesale lots to the contractor at the same price that they do to the dealer. It was disclosed that conferences with this end in view had been held with cement manufacturers both in the east and in the middle west. There was unanimous agreement that the present practice of allowing the dealer a differential in cases where he performed no service whatsoever was indefensible. It was the feeling that the practice would be changed if groups of contractors in every part of the country would bring their influence to bear upon the cement manufacturers.

Officers of the public works division elected for 1923 were: Chairman, Charles V. Burkhart, Chicago; vice-chairman, R. A. Schaffner, St. Paul; of the railroad division, chairman, A. S. Doney, Seattle; vice-chairman, Frank Stuart, Boston.

At the general session on Thursday morning John W. Cowper, Buffalo, chairman of the Committee on Contracts, stated that much progress had been made toward drafting a desirable contract form and that clauses releasing retained percentages would be included. Particular emphasis was placed on the fact that for the first time joint conferences have been held by engineers, architects, and contractors to co-operate in drafting better contract forms. Through the co-operation of the government interdepartmental board there is even good prospect of incorporating in Government contracts a clause providing for arbitration before a board of review. Discussion showed a very general belief that the problem of securing fair contracts is of the very greatest importance to the industry.

W. O. Winston, Minneapolis, explained in detail the action of the association last year in borrowing money to carry on work that would cost about $50,000 more than the year's receipts. He stated that, although this was done in accordance with the best judgment of the board, it has since been definitely decided that no more of the bonds would be sold and that money would not be borrowed again under any circumstances. General discussion showed the sentiment to be very strongly against spending in any year more than the actual receipts for that year and there was unanimous approval of the new budget program which limited the expenditure for the coming year to $125,000 or such part thereof as is to be received by the association as income for the year. In conjunction with this budget it was voted that the present system of dues should be abolished and instead members should pay according to the following classification: Chapter members who shall pay $30 per year, co-operative members who shall pay $250 per year, sustaining members who shall pay $500 per year, provided that each chapter shall have at least one co-operating membership for each ten members or major fraction thereof, individual members shall pay dues as sustaining or co-operating members. The executive committee was also authorized to reclassify the dues of the present individual members as in their judgment is in the best interest of those members and of the association.

Regarding the additional cost these dues would place on small chapters Frederick Cranford stated he believed plans could be worked out in each case that that would be satisfactory. Representatives from several comparatively small chapters believed their chapters would accept the new dues schedule.

President-elect Cowper stated that with the withdrawal of field secretaries incidental to the curtailment of expenses necessary this year special effort must be directed toward getting new members and that he planned to appoint James H. Ellison, Minneapolis, chairman of the membership committee, and would name all chapter chairmen as assistants.

William B. Joyce chairman of the Board of Directors, and George W. Allen, Pacific Coast Representative, National Surety Co., made addresses in which they pointed out changes necessary to improve the conditions under which bonding companies write bonds for contractors. Ninety per cent of the losses of this company in the contracting business are due to false financial statements submitted by the contractors.

President Cowper's Address

On assuming his new duties as president, Mr. Cowper made a short address in which he emphasized the importance of establishing skill, integrity, and responsibility as the watchword of the association. He pointed out that the volume of building work would likely be restricted due to rising costs and indicated desirable modifications of immigration laws so as to admit immigrants who would fit well into our social system. He commended the formation of the American Construction Council and urged that among other things it combat the erroneous propaganda that public works should be done without the aid of those skilled experienced and regularly engaged in such work. He commended the broad scope of the council's proposed activity and concluding placed special emphasis upon the need for every agency of influence to assist in securing a proper public attitude toward our transportation system, particularly our railroads, because upon their prosperity and progress depends industrial and agricultural development.

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 13-15.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The American Society of Safety Engineers and the Engineering Section of the National Safety Council will hold a joint meeting Feb. 16 in New York.

The Engineering Society of Wisconsin will hold its annual meeting at Madison, Wis., Feb. 22-24. Two joint sessions will be held with the Wisconsin Drainage Society. There will be also a joint meeting and banquet with the Madison Technical Club. Papers announced include "The Drainage of Highways" by E. A. Rossiter, Chicago, with discussion by A. R. Hirst, state highway engineer of Wisconsin; "Relations of Drainage and Sanitation," by L. K. Sherman, Chicago, and "Control of the Neenah Dam," by Geo. Randall, Oshkosh, Wis.

The North Dakota Society of Engineers and the North Dakota chapter of the American Association of Engineers will hold a joint annual meeting on Feb. 20 and 21. The first day will be spent at Mandan and the second at Bismarck.

The Indiana Sanitary and Water Supply Association will hold its annual meeting Feb. 14 and 15 at Indianapolis. Round-table discussions on meters, operating troubles and water use by contractors, as well as papers on municipal water softening, centrifugal pumps, and the Bloomington (Ind.) situation are on the program.

The New England Water-Works Association will hold its annual meeting Feb. 13 at the Boston City Club.

Personal Notes

Franz and Bond, architects and engineers of Holyoke, Mass., have dissolved in order that Philip Bond may give his entire attention to his duties as city engineer, to which office he has recently been appointed. He succeeds J. T. McCarthy. Fred H. Franz will continue the practice of architecture under the firm name of Franz and Bond.

John E. Palmer Co., Inc., of Boston, Mass., has recently been incorporated to engage in general engineering work. The president of the concern is Daniel S. Bell, of Boston; and the treasurer is John E. Palmer, Dorchester, Mass.

RAYMOND J. CURTIS, for many years connected with the county highway department, has lately been appointed by the Board of Supervisors as county engineer of Herkimer County, N. Y. Mr. Curtis succeeds William H. Corey, of Salisbury Center, who has held the office for the past 14 years.

W. J. KELLY, county engineer of Trinity County at Trinity, Texas, has been appointed county highway engineer of Montgomery County. He is stationed at Conroe.

ALVIN L. WHITE, who has been resident engineer on state highway projects in Reeves and Jeff Davis Counties, Tex., has been appointed county engineer of Brewster County.

I. E. HOUK, city engineer of Dayton, Ohio, has been elected president of the Dayton Chapter of the American Society of Civil Engineers. He succeeds Charles H. Paul. CHARLTON PUTNAM was elected vice-president and C. H. EIFFERT, maintenance engineer of the Miami Conservancy District, secretary and treasurer.

ROSS ALVERSON, Everett, Wash., has been elected county engineer of Snohomish County, succeeding F. G. TEGTMEIER.

A. H. DIMOCK, consulting engineer, Seattle, until recently city engineer of that city, has been appointed to take charge of the investigation and survey of the water situation in Bellingham, Wash.

CHARLES H. LEE, consulting hydraulic engineer of San Francisco, Calif., has been appointed lecturer in civil engineering at the University of California and during the spring term will give a course in water-supply engineering. This course was formerly conducted by Prof. Chas. Gilman Hyde, who expects to spend the coming six months in Europe.

H. B. MILLER, consulting engineer formerly manager of construction and director of supplies and sales for the U. S. Shipping Board, has been appointed assistant city engineer, Chicago, a position held by the late C. F. Healey. Mr. Miller was graduated in 1912 from the University of Pennsylvania, and for 5 years was assistant engineer with McClintic-Marshall Co. at Pittsburgh.

COL. FREDERICK STUART GREENE, who was Commissioner of Highways of the State of New York when Alfred E. Smith served his former term as governor, has been reappointed by Governor Smith as Commissioner of Highways, succeeding Herbert S. Sisson, the appointee to the position of ex-governor Miller. He entered consulting highway practice upon his resignation in 1921. Col. Greene has had broad professional experience, having early in his career been employed in railroad construction work, as well as in designing and building of terminal facilities. Previous to his entering highway engineering he was for several years with the American Manufacturing Co. of New York City as consulting engineer on transmission of power by rope.

WILLIAM H. CONNELL of Germantown, Pennsylvania, has been appointed deputy state highway commissioner for Pennsylvania by Governor Pinchot. Mr. Connell for many years previous to 1912 was in public engineering work in New York City. From 1910 to 1912 he was deputy commissioner of public works of Bronx Borough. From 1912 to 1917 he was chief engineer of the Bureau of Highways and Street Cleaning in Philadelphia. Since then he has been engaged in private practice. For two years he was executive engineer for Day & Zimmerman of Philadelphia and from 1919 to very recently with the Philadelphia Rapid Transit Co.

WILLIAM S. DAVIS, chief engineer of the Mangan & Risser Contracting Co., Lebanon, Pa., has been appointed city engineer of Lebanon, succeeding PAUL VOLCKER, who has become secretary of the Lebanon chamber of commerce.

HARRY E. HARRIS, Bridgeport, Conn., engineer specializing in manufacturing methods, will carry on under the name, Harry E. Harris, consulting engineer, the work formerly conducted by Hubbard, Harris & Howell, Inc., Bridgeport.

A. E. CHRISTHILF, former highway engineer of Baltimore, Md., has been appointed chief engineer of that city; and his successor as highway engineer is CHARLES F. GOOB, who has been chief engineer of the electrical commission of Baltimore.

ALAN J. O'BRIEN, formerly New York representative of Blome Sinek Co., Chicago, has opened offices in Long Island City, N. Y., under the name of A. J. O'Brien Co., which will specialize in industrial design and construction.

E. B. FITHIAN has been appointed district engineer of the western district of the Missouri Pacific R.R. Co., with headquarters at Kansas City, Mo. He succeeds C. O. Congdon, resigned.

EUGENE A. BALSLEY and ALBERT E. FISK have opened a consulting office at 30 N. La Salle St., Chicago, under the firm name of Balsley & Fisk. Mr. Balsley has been with the American Bridge Co. for the past 20 years. He was graduated from the University of Wisconsin in 1902 and immediately entered the erecting department of the bridge company. In 1905 he was made assistant manager and two years later was transferred to the Milwaukee plant as manager, where he remained until 1916 when he was appointed assistant operating manager of the western division and manager of the forge division. This position he held until his resignation Jan. 1, to engage in private practice. Mr. Fisk's engineering experience has been obtained with the American Bridge Co., Mead-Morrison Manufacturing Co. and Freyn, Brassert & Co.

ROBERT E. BARRETT, Holyoke, Mass., has been elected president of the Holyoke Water Power Co., which controls practically all the water power in the large manufacturing districts surrounding the city of Holyoke. Mr. Barrett has had long experience in hydroelectric and harbor design and construction in New England. After leaving Harvard University in 1905 he became connected with the work of the Charles River Basin Commission which he left in 1907 to become assistant engineer and designer of the Board of Water Supply on the Catskill Aqueduct. From 1910 to 1913 he was on construction work on that aqueduct, returning in 1913 to Boston to become designing engineer of the Directors of the Port of Boston. From June, 1915, to August, 1916, he was acting chief engineer of that organization. In 1916 he became associated with Fay, Spofford and Thorndike, consulting engineers of Boston, on the design and foundation of the new bridge crossing the Connecticut at Springfield, leaving that work in 1917 to become construction engineer of the Turner Falls Power & Electric Co. In February, 1918, he became general manager and chief engineer of the Connecticut River Conservation Co. and some time later became connected with the company of which he is now president.

GEORGE H. BILES, for the past year acting state highway commissioner of Pennsylvania, has resigned. He was in full charge of all activities in the state highway department from the death of the late commissioner, Lewis S. Sadler, until the appointment of the new commissioner January 16, 1923 (See *Engineering News-Record*, January 18, p. 137). Mr. Biles had been connected with Pennsylvania road work for the last fifteen years. He carried on first experiments for that state in bituminous surface treatment materials. In 1913 he organized the maintenance division of the Pennsylvania State Highway Department, with supervision over 10,000 miles of highway and employing over 12,000 men in the peak seasons work. In 1919 Mr. Biles conceived and executed plans for the complete re-organization of the Pennsylvania State Highway Department. This organization at present with its accounting system is said to be the most comprehensive of its sort. Mr. Biles is a licensed professional engineer and land surveyor, a member of the American Society of Civil Engineers, the American Society for Testing Materials, the American Road Builders' Association and the American Association of State Highway Officials.

Obituary

HARRISON M. RANDEL, for eight years county surveyor at Greencastle, Ind., died recently at his home there, aged 84 years.

GORDON EMSLIE, civil engineer of Montreal, died in that city Jan. 23, aged 74 years. Mr. Emslie was for over 30 years connected with the Dominion Bridge Co. and for 8 years was on the board of engineers which had charge of the construction of the Quebec Bridge. He was a graduate of Ontario University.

LIEUT.-COL. J. A. HESKETH, C.M.G., D.S.O., of the engineering staff of the Canadian Pacific Ry., died at Winnipeg, Jan. 26, aged 57 years. His overseas service was with the Lord Strathcona Horse and he was afterward attached to the engineering corps. He was born in England and was a graduate of the Royal Military College, Kingston, Ont.

WILLIAM LLOYD, SR., contractor and builder in Johnstown, Pa., from 1880 to 1903, died in that city Jan. 22, aged 87 years.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

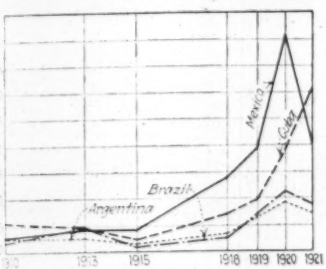
Analysis of Foreign Machinery Markets Shows Export Opportunity for U. S. Manufacturers

By W. H. Rastall

Chief, Industrial Machinery Division, U. S. Department of Commerce
Washington, D. C.

IN THE machinery trade 1923 promises to be a year of exceptional opportunity for the export manager, but in making his plans he should carefully analyze the whole field and devote his energies to the expanding markets as never before.

In 1910, the United States exported $51,489,598 worth of industrial machinery. In 1921, this had expanded to $246,436,364. Export business has become five times as important to the machinery producer as it was a decade ago, as the average shop exports nearly 20 per cent of its product, a ratio that is rising rapidly. Shops as far west as Wisconsin, that produce heavy machinery exclusively, have exported as much as 60 per cent of their total production. American engineering equipment is now going to practically every country in the world in rapidly increasing quantities.

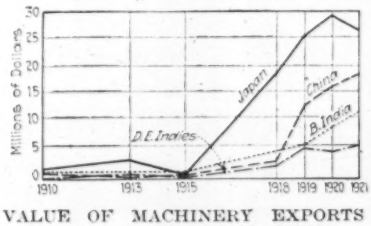


VALUE OF MACHINERY EXPORTS FROM U. S. TO LATIN AMERICA 1910-21

The merits of American machinery have long been recognized in foreign countries, but events since 1914 have given our equipment a definite prestige. Most of the countries of the world are disposed to buy high-class machinery in larger quantities than heretofore. Also, European manufacturers are finding it difficult to conduct their businesses under present conditions. All these circumstances create a situation that offers the American machinery manufacturer an unusually favorable export opportunity.

In order that sales effort may be expended most effectively, the accompanying table is presented showing the 30 most important foreign markets arranged in the order of their importance, as shown by the volume of American machinery absorbed in 1921, but including data for 1919, 1913, and 1910, to show the nature of the changes that have taken place. These data show clearly that Canada is our best foreign market, having ranked 2, 1, 1, 1, in 1921, 1919, 1913, and 1910, respectively. Mexico reached first place in 1921, but because of various disturbances ranked 1, 9, 4, 2, in this series of years. It will be noted that in 1921 there were 29 different countries that absorbed more than $1,000,000 worth of American machinery, a volume that justifies the sales manager in developing a carefully planned export campaign unless other factors intervene.

During recent months the situation in Europe has discouraged certain of our manufacturers from making an active push for export business, for in pre-war days our best machinery markets were in Europe. It will be noted, however, that in the first 20 countries mentioned in the table (on page 280) only 3 are in Europe, while the other 17 are largely free from the troubles resulting from the war. Nine of the first 15 countries have progressed to a point where the currency depreciation is less than 5 per cent. However, it is not the *rate* of exchange that makes business difficult but the *fluctuations* in exchange. In the above cases the fluctuations have all but disappeared, or at any rate the swings have become very narrow, and such changes as do develop are usually in a direction that promotes American export trade. Reconstruction has now reached a point where, for most countries, our position will continue to grow better.



VALUE OF MACHINERY EXPORTS FROM U. S. TO JAPAN, CHINA, BRITISH INDIA, AND DUTCH EAST INDIES, 1910-21

The machinery export manager should also recognize the development that has taken place in many of these markets during the last decade, as shown by the data in the table. For example, China took $260,431 worth of our machinery in 1913, but this had grown to $18,184,978 in 1921. Such development calls for radical readjustment of sales plans. British India expanded from $628,063 in 1913 to $10,772,891 in 1921; Japan from $1,741,402 in 1910 to $20,941,408 in 1921; Mexico, Cuba, Brazil, Argentina, Peru, Chile, Philippines, Netherland East Indies, etc., have shown remarkable expansion, as is indicated by the accompanying charts. All this information indicates clearly that there are splendid opportunities for the sale of American

(Continued on p. 280)

High-Grade Materials Urged for Concrete Mixtures

National Sand and Gravel Association Plans Educational Campaign—Hoover Discusses Priorities

Washington Correspondence

A NATIONAL campaign intended to point out the advantages of using high-grade materials only in concrete mixtures is to be undertaken by the National Sand and Gravel Association. The proposal was brought out by the board of directors during the annual meeting of the association in Washington January 24-26, and was approved unanimously on the floor of the convention. While the principal effort will be to convince contractors that it is poor economy to use low-grade sand or other materials in mixing concrete, a publicity campaign will be undertaken to acquaint the public with the fact that the value of an investment in concrete depends to no small extent on the grade of the aggregates used in connection with the cement.

Edwin W. James, of the U. S. Bureau of Public Roads, pointed out to the gathering that every effort is made on federal-aid roads to insure the use of high quality material by contractors. Within the last few months, he said, the bureau has assigned a specialist on qualities of road materials to each of the district offices.

Against Priority Orders

Much of the discussion at the sessions revolved around the Interstate Commerce Commission's priority orders. There was a great round of applause when Secretary Hoover told the convention that he does not approve of priority orders. He declared that the open-top car situation in the winter months could be relieved very materially if the railroads would haul and store their own fuel during the months when there are surpluses of open-top cars. There was abundant testimony from the floor of the abuse of the priority orders, and actual records were taken by many sand and gravel companies to show that cars stood for weeks or months on the sidings at coal mines.

E. H. Degroot, of the Interstate Commerce Commission, talked of the transportation situation from the commission's standpoint. He called attention to the fact that relief had been afforded to the extent of thousands of cars when sand and gravel producers called their specific energies to the attention of the commission.

New Officers

Alexander W. Dann, of the Keystone Sand & Supply Co. of Pittsburgh, was reelected president of the organization. E. Guy Sutton, of Danville, Ill., was elected vice-president; John Prince, of Kansas City, was reelected treasurer, and T. R. Barrows, executive secretary. E. C. Ross, of Parkersburg, W. Va., U. L. Smith, of Memphis, R. C. Fletcher, of Des Moines, and Hugh Haddow, Jr., of Millville, N. J., with the foregoing officers will comprise the new executive committee.

Representative Casper, of the Interstate and Foreign Committee of the House of Representatives, another of the speakers, was severe in his criticism of the Railroad Labor Board.

Foreign Market for Machinery

(*Concluded from p. 276*)

machinery abroad and that it is not wise to pay too much attention to reports regarding Europe where the markets are contracting. It is far better to employ constructive sales effort in the markets that are expanding. The following statement may be useful:

Canada.—This has long been our best market for industrial machinery, and this market should show good results in 1923 as Canada is probably the most prosperous country in the world, and its exchange problems have disappeared. Plans have been prepared for important water-power plants, paper mills, grain elevators, highway construction, and a large number of other operations, and it would appear that these will require much American machinery.

United Kingdom.—Exchange is now at a discount of less than 5 per cent and improving rapidly. On July 31, 1921, it stood at 375.25, a discount of about 22.8 per cent, so that there has been very creditable recovery. Many of the factories in England are in need of new labor-saving machinery, as the old equipment has not been adjusted to the present high-labor costs. Machinery of the types required must be purchased in the United States as it has not yet been developed elsewhere. Also, it is felt in the United Kingdom that 1923 is to witness a boom in British trade. It would not be surprising if American machinery business showed great progress in England this year.

France.—The franc was valued at 20.22 cents on July 30, 1914, 7.61 cents July 31, 1920 and 7.02 cents Dec. 1, 1922. Although conditions are unsettled many very important engineering projects are to be developed and appropriate equipment will be required. This market may not show much expansion in 1923.

Australia.—This country, as a market, ranked 12, 16, 9, 8 in 1921, 1919, 1913 and 1910 respectively. The exchange rate is much the same as for the United Kingdom. Readjustment has now advanced to a point where the commonwealth can take up constructive problems, interrupted during the war, and work that is several years behind should now be brought down to date. A large number of projects are contemplated. New Zealand is in a somewhat similar position and there is a strong desire to industrialize both countries. In doing this they should use a great deal of American machinery.

South Africa.—Has ranked 17, 19, 13, 12. A very large amount of American mining machinery is used there. Also, there is a growing demand for other classes of machinery. This territory gives promise of rapid development and American equipment is very popular there.

Spain.—Has ranked 19, 18, 16, 25. The peseta was worth 19.6 cents July 30, 1914, 15.52 cents July 31, 1920 and 15.36 cents December 1, 1922. This market offers attractive prospects, but one gathers the impression that many of our manufacturers should improve their methods of handling Spanish business.

Egypt.—Has ranked 23, 13, 31, 29, and exchange is no longer a serious consideration there. One gathers the impression that American machinery has never been properly represented in the Nile Valley and that constructive methods would be well repaid.

Netherlands.—Has ranked 24, 22, 17, 17. The guilder was worth 40.75 cents July 30, 1914, 34.5 cents July 31, 1920 and 39.52 cents December 1, 1922, a negligible discount. Very closely associated are the markets of the Netherlands East Indies that ranked 13, 17, 25, 27, expanding from $84,448 in 1910 to $5,061,080 in 1921. This group will probably show a handsome expansion in response to proper sales effort.

COMPARATIVE VALUE OF THE FOREIGN MARKETS FOR AMERICAN MACHINERY

Country	1921 Rank	1921 Value	1919 Rank	1919 Value	1913 Rank	1913 Value	1910 Rank	1910 Value
Mexico	1	$30,784,076	9	$9,623,381	4	$4,998,262	2	$5,038,786
Canada	2	28,474,868	1	56,872,104	1	32,573,274	1	14,129,298
Cuba	3	21,307,814	5	19,618,436	6	4,125,049	5	2,404,592
Japan	4	20,941,408	4	25,021,786	8	3,314,435	10	1,741,402
China	5	18,184,978	7	12,149,039	28	260,431	15	641,732
United Kingdom	6	18,019,508	3	38,522,254	2	10,435,835	3	4,594,241
France	7	14,364,119	2	38,856,748	7	3,622,486	7	1,994,728
British India	8	10,772,891	15	4,822,136	22	628,063	19	516,438
Brazil	9	8,737,477	10	6,696,225	5	4,835,621	9	1,809,389
Argentina	10	8,007,785	11	6,407,357	10	2,428,017	6	2,168,565
Philippine Islands	11	5,529,555	8	10,007,110	11	1,489,836	18	532,361
Australia	12	5,510,167	16	4,604,588	9	2,999,321	8	1,877,985
Netherlands E. Indies	13	5,061,080	17	4,546,249	25	424,314	27	84,448
Peru	14	3,770,184	20	3,045,582	19	755,004	21	255,666
Chile	15	3,561,510	12	5,652,134	14	1,085,599	14	703,270
Dominican Republic	16	3,252,954	24	1,069,168	18	884,377	22	254,995
British S. Africa	17	2,907,183	19	3,208,622	13	1,177,207	12	1,177,324
Colombia	18	2,729,690	25	752,320	21	632,868	24	229,598
Spain	19	2,505,039	18	4,005,721	16	929,450	25	228,459
New Zealand	20	2,144,897	23	1,078,195	23	508,644	20	305,487
Sweden	21	1,957,928	21	2,210,253	24	497,260	23	254,652
Belgium	22	1,836,167	14	5,147,196	12	1,340,345	13	711,388
Egypt	23	1,733,625	13	5,173,893	31	69,753	29	46,011
Netherlands	24	1,600,471	22	1,854,492	17	925,361	17	593,925
Venezuela	25	1,422,439	29	571,365	26	388,100	26	110,680
Trinidad and Tobago	26	1,385,920	30	287,777	30	109,293	31	.....
Rumania	27	1,311,582	28	639,037	27	296,303	30	23,880
Honduras	28	1,249,762	31	248,934	29	120,529	28	63,991
Italy	29	1,054,653	6	12,250,311	15	931,383	16	604,794
Panama	30	982,941	26	761,668	20	722,946	11	1,325,523
Germany	31	628,893	27	655,300	3	5,259,454	4	3,177,648

The above returns include only industrial machinery. In 1921, no other country absorbed as much as a million dollars' worth of American machinery. Certain countries not here shown may have absorbed more equipment than Honduras in 1919, Egypt in 1913, etc.

To Exhibit Equipment at Jersey Highway Convention

A highway industries exhibit of materials and equipment will be a feature of the third annual New Jersey State Highway Convention, to be held at the Stacy-Trent Hotel, Trenton, Feb. 14-17. A number of technical papers and discussions also are being planned.

Lack of space this week has made necessary the omission of the discussion on "Better Equipment Maintenance and Repair Parts Service," which has been appearing in recent issues.

The discussion will be resumed next week by comment from the Jeffrey Manufacturing Co., Columbus, Ohio, makers of conveying and crushing machinery.—EDITOR.

Business Notes

FRED H. CHESTNUT has resigned from the White Co., where he held the position of transportation engineer for the Pacific Coast district with headquarters in San Francisco, and has become vice-president of the Anderson-Endebrock, Inc., Pacific Coast distributors of Trailmobiles.

WILLIAM P. WAUGH, consulting engineer for the H. H. Robertson Co., Pittsburgh, manufacturer of roofing and building products, and widely known through his development of skylights and the solution of ventilation problems for industrial plants and public buildings, died at his home at Sewickley, Pa., Jan. 15. He was born in Hedrick, Iowa, and attended Iowa State College. His early work was in the railway field, where he was associated with John F. Stevens. Mr. Waugh was employed as secretary to Mr. Stevens until 1888, when he went to Los Angeles and Santa Barbara, Calif., on independent surveys for a number of firms. Later he was employed on the construction of the St. Louis water-works tunnel under the Mississippi River and on construction work for the Chicago drainage canal.

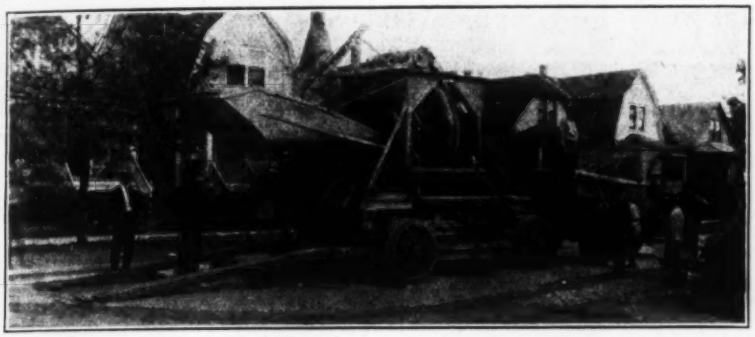
Mr. Waugh next joined the James G. Wilson Manufacturing Co., St. Louis, going to New York later as sales manager in the New York district, where he remained for 12 years and became interested in the need for better skylight construction. For two years he was connected with Irving F. Orr, of the Clason Architectural Metal Works in Providence, R. I., in the development of what was then known as the Waugh type of skylight. While with this company he built the skylights now in use on the Boston Museum of Fine Arts.

Mr. Waugh then joined the H. H. Robertson Co., with which he remained until his death. During this period his skylights were developed to their present state. Some of his most notable installations are those on the Cadillac, Packard and Dodge motor company plants in Detroit, the Indianapolis Union Station, and the Centennial Memorial Building at Springfield, Illinois. During this period he also developed a double glazed skylight that is widely used on paper mills and in textile plants where drippage must be constantly guarded against.

Equipment and Materials

Rubber-Tired Transfer Trailer for Paving Mixer

For quick transportation of paving mixers and other heavy construction equipment a four-wheeled rubber-tired trailer has been built by the Foote Concrete Machinery Co., Chicago. Units of the type illustrated in the accompanying photograph have been supplied to the White Paving Co., Chicago, and H. G. Goelitz Co., municipal contractors, Oak Park, Ill., both of whom report substantial savings in time in moving from one job to another and reduced wear and tear on equipment. The



trailer is designed to be operated at motor truck speeds of from 12 to 15 miles per hour.

The trailer has a capacity of 13 tons, and an underslung frame, the top of which is only 2 ft. above the ground so that a crawler-mounted paver can run up onto the platform on inclined runways under its own power, the loading operation taking only 5 min.

The platform is of 4-in. oak, 93 in. wide and 156 in. long and is supported by three 8-in. I-beams reinforced with 6-in. channels. The wheels are equipped with solid rubber tires 40 x 8 in. on the front and 40 x 12 in., on the rear, and tractive resistance is lowered by the use of Hyatt roller bearings. The shipping weight of the trailer is about 8,000 lb.

Light Gasoline Roller for Subgrade and Maintenance Work

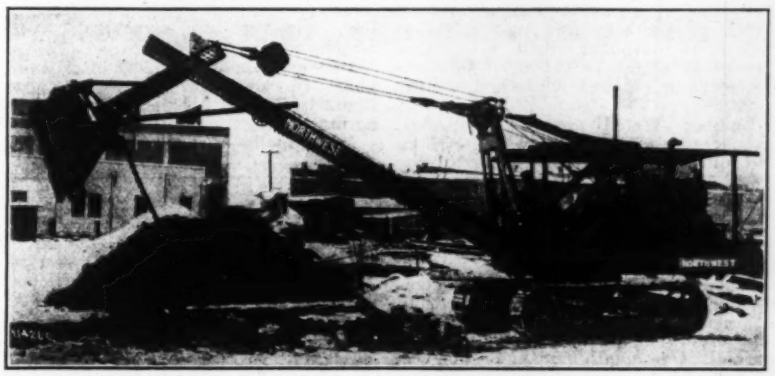
For rolling subgrades of concrete roads and for maintenance work when equipped with scarifying and planing blade attachments, the Austin-Western Road Machinery Co., Chicago, has introduced a 3-ton, three-wheel motor roller designated as the "Pup." The machine has been designed to meet the requirements of the Illinois State Highway Department for a 3-ton power roller for subgrade work. It is claimed by the manufacturers to be the first three-wheeled power roller weighing less than 7 tons to be placed upon the market. The power equipment is that of the Fordson tractor except that the high speed has been blocked out as too fast for roller operation. Two lower speeds of 1½ and 2¾ miles per hour are available.

The rear wheels have an 18-in. and the front wheel a 31-in. face, resulting in compressions per linear inch respectively of 114.4 and 60.7 lb. The rolling width is 5 ft. and the lap between front and rear rolls 3½ in.

On maintenance work the roller serves as a tractor. In that case the front end is equipped with a leveling blade, the weight of the roller being applied to the blade to prevent its riding over hummocks. Folding wings are attached to each end of the blade, increasing its width from 5 to 8 ft.

Trench Hoe Attachment for Locomotive Crane

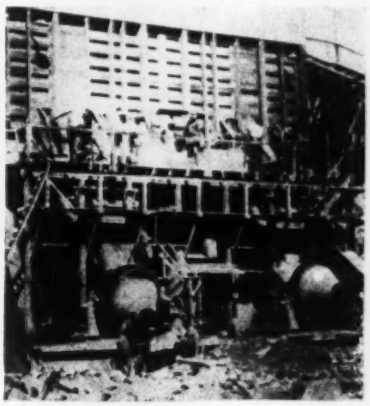
A new interchangeable attachment, in the form of a "trench hoe," for its crawler-mounted locomotive crane is announced by the Northwest Engineering Co., Chicago. The device, exhibited for the first time at the Good Roads Show in Chicago last month, consists of a boom, dipper arm, and a dipper which digs toward the machine instead of away from it as is the case with a steam shovel dipper. The attachment is designed especially for trench excavation and will dig to depths of 14 or 20 ft., depending on the length of the dipper stick. Dippers are furnished in four widths, 27, 35, 40, and 48 in.



Among the advantages claimed for this ditcher attachment is that the machine operates on solid ground and does not have to straddle the trench as does a steam shovel, thus doing away with mats. It is asserted, also, that there is no loss of digging power at great depths as with a steam shovel equipped with extra long dipper stick. It is pointed out also that the ditcher attachment may be used successfully in handling blasted rock. In ordinary earth the manufacturers quote from 400 to 600 cu.yd. as the volume of material that the machine will handle in a 10-hour day.

American Concrete Mixers on South African Dam

American construction equipment is speeding the completion of the Hartebeestpoort dam in South Africa, a project, including canals, on which a labor force of 3,000 is at work. Concrete is mixed in a central plant where two 28-S mixers made by the T. L. Smith Co., Milwaukee, are used.



Two methods are employed for the delivery of concrete to the job. In the first the mix, after being dumped into 1-yd. steel trucks, is trammed to a point of delivery into an inclined wooden chute. In the other the concrete is handled by a cableway rigged to carry two truck bodies at a time. In addition to the concrete plant just mentioned, there is a third American machine, a 10-S Smith mixer, for miscellaneous work.

Easton Car & Construction Co., Easton, Pa., has issued an illustrated folder describing its roll-over bodies for Ford and other trucks on road construction. One of the bodies is equipped with watertight cement compartment.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Production and Materials Stocks in Nine Cities

Steel and Lumber Output Increasing—Cement and Brick Slower —Mill Deliveries Held Up by Rail Embargoes

Steel—Mill operations continue to increase, with further expansion expected during current quarter. Operations at about 80 to 85 per cent of capacity. Orders now on books would accommodate full capacity output but for labor shortage and transportation difficulties. Annual ingot production rate of 42,000,000 to 45,000,000 tons expected to be reached before end of next month.

Lumber—Weekly gains in production, shipments and orders may be noted in the following comparisons:

Week Ending	No. of Ft. Cut	No. of Ft. Shipped	No. of Ft. Ordered
Dec. 30, 1922	120,551,907	180,695,550	173,411,023
Jan. 6, 1923	162,219,452	200,245,297	181,805,237
Jan. 13, 1923	187,673,033	246,606,718	291,377,943
Jan. 20, 1923	202,843,438	251,908,414	328,159,215

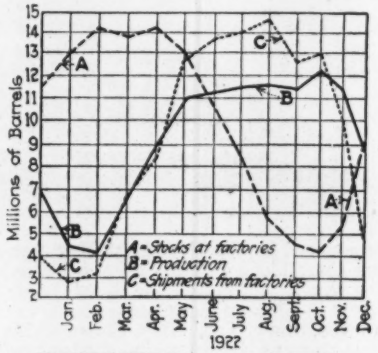
The National Lumber Trade Barometer, Feb. 2, shows production at 10 per cent below; shipments 8 per cent and orders about 26 per cent above, normal. One month ago the output was 50 per cent; shipments 23 per cent and orders 24 per cent below normal. A year ago production stood at 15 per cent; shipments 30 per cent and orders 22 per cent below normal.

Cement—Production and shipments of finished portland cement at mills, have shown seasonal declines since October, 1922. Beginning at the same time, reserve stocks of cement at factories began to increase, until the quantity on hand at present about equals the rate of output, namely 9,000,000 bbl.

San Francisco—Ample supplies of railway materials, metal lath, reinforcing bars, triangle mesh, hollow tile, lumber and cut nails. Large stocks of road oils, asphalt, common brick, structural steel, galvanized sheets and manila rope. Plenty of sewer pipe and fair quantities of lime, black and blue annealed steel sheets, available. Stocks low, however, on structural rivets, cement and wire nails.

Denver—About 3,000,000 brick available. Stocks of other materials, particularly lumber, being maintained at normal levels.

Minneapolis—Dealers stocks of brick, tile, cement and lime, well kept up; materials available at short notice. Lumber stocks normal for season and adequate to demand which is necessarily low at this time of the year. Estimated 100,000,000 ft. in Twin City yards, including wholesale reserves.



FLUCTUATIONS IN FINISHED PORTLAND CEMENT

Detroit—Enough sewer pipe in yards to satisfy immediate demands. Sufficient cement stocks, in nearby mills; increased slightly. Prompt lime deliveries from Michigan and Ohio kilns. Enough brick in local yards. Large deliveries of hollow tile take several days; enough on hand in city to meet demands. Lumber stocks somewhat decreased, only moderate quantities in yards. Small supply of asphalt in storage but deliveries prompt. Sand and gravel shipments in carload lots hampered by breezing weather.

New Orleans—Lumber stocks normal. Mills not yet caught up with orders previously received, which they had been unable to fill, owing to car shortage. Freight service definitely improved.

Atlanta—Plenty of common brick, pine lumber and asphalt. Deliveries take from four to six days on hollow tile and from six to eight, on sewer pipe. About five carloads of structural steel on sidings; twenty-five to thirty, of lime and twenty cars of cement.

New York—Rail embargoes seriously affecting shipments of building materials. Dealers' stocks sufficient under present seasonal conditions, but the usual increase in demand for freight cars in the early spring will undoubtedly cause delayed mill deliveries and thereby impoverish dealers' reserves. Hudson River brick shipments blocked by ice. Threatened shortage of expanded metal lath.

Philadelphia—Shortage of sewerpipe. Brick supply consumed as fast as produced. Sand, gravel and crushed stone movements not impeded by weather conditions. Lumber yards short on nearly all sizes; buying for actual requirements only and not for reserve.

Boston—All materials plentiful except fir and hemlock lumber.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Lumber, Minneapolis, 100,000,000 ft.); time required for delivery of carload lots to city job, example: (hollow tile, Atlanta, 4 @ 6 days); and stocks on hand in general terms, example: (sewer pipe, Philadelphia, shortage.)

	San Francisco	Denver	Minneapolis	Detroit	New Orleans	Atlanta	New York	Philadelphia	Boston
Sewer pipe	Plenty	Del. 24 hr., local plant	Sufficient	Satisfying immediate demands	Fairly well supplied	Del. take 6 @ 8 days	Mill del. slow	Shortage	Plenty
Cement	Small reserve	Normal	Large quantities	Nearby mill stocks sufficient	Sufficient	20 cars	Enough for present requirements	But slightly recovered from recent depletion	Well supplied
Lime	Fair supply	Plenty	Ample	Prompt del. from Mich. and Ohio kilns.	Enough	25 @ 30 cars	No shortage	About 30 cars	Sufficient
Common brick	Large quantities on hand	3,000,000	Available at short notice	Enough in local yards	Large supplies	Plenty	Hudson River del. blocked by ice	Demand greater than supply	Enough
Hollow tile	Fair supply	Stocks in normal condition	Sufficient	Large del. take several days	About enough	Del. take 4 @ 6 days	Nearby plants; water deliveries	Stocks low	Ample reserves
Lumber	Heavy stocks	Normal level maintained	100,000,000 ft.	Moderate; somewhat decreased	Normal; car service improved	Plenty pine	Del. take 6 @ 8 weeks from mill	Sufficient for actual requirements only.	Plenty pine and spruce
Asphalt	Extensive native reserves	About 10 cars	Enough	Small supply in storage	No market	Plenty	Heavy reserves in N. J.	Well stocked supply center	No shortage
Structural steel	Plenty bars and shapes; low on rivets	Warehouse stocks sufficient	Meeting all demands	No shortage	Sufficient for present	5 cars, approximately	Slow mill shipments	Harder to get quick del. on shapes	Mill del. slow

Figures on Which to Base a Construction Forecast

Can you give me any figures on which to base a forecast of the volume of construction that may be expected in the early part of 1923?—SUBSCRIBER.

First of all, past performances must be studied. Of these the *E. N.-R.* Construction Volume Index Number deserves particular consideration, as it shows the rate at which contracts were awarded in the months of the last three years compared with the 1913 rate of 100. It will be seen from the following table that the number has been well above 100 since March, 1921:

E. N. R. CONSTRUCTION VOLUME INDEX NUMBER
1913 and 1920–23
(1913 = 100)

	1923	1922	1921	1920
January	126	91	41	146*
February	...	100	43	114
March	...	202*	88*	107
April	...	150	86	142*
May	...	179	90	107
June	...	187*	117*	74
July	...	118	90	85*
August	...	154*	94	65
September	...	129	114*	85*
October	...	127	109	73
November	...	122*	101	51
December	...	111	118*	58*

*Taken from five issues of *Engineering News-Record* during month.

Of course, these are figures of contracts actually awarded, and the builder is interested in indications of the volume of proposed work not yet out for estimate. But it will be observed that the volume index was above 100 for every month in 1922, except the first two. This means that the volume of new work developing must also have been greater than "normal."

The table which follows presents figures on large general projects of all kinds arising in each of the last four years, as reported by Construction News. It gives the number of jobs proposed, the number on which bids were invited and the number of contracts awarded. Of course, many of these were the same job at successive stages:

	Contracts Awarded	Bids Desired	Proposed Work
1922	8,140	7,118	11,280
1921	7,047	6,831	11,699
1920	9,249	6,028	11,709
1919	6,993	4,789	13,861

The above figures do not include residential building or small construction.

Following are some figures on value of building permits furnished by R. G. Dun & Co.:

	1922	1921
New York	$603,742,425	$444,782,820
Boston	55,616,604	23,610,841
Philadelphia	125,414,480	.....
United States	2,514,435,467	(52% under 1922)

Number of large building projects compared with the total number of large projects, reported in Construction News, are shown for both the "Eastern District" and the whole of the United States and Canada. The Eastern District comprises the whole of New York State, northern New Jersey south to Princeton Junction, and Connecticut north to Stamford:

1922	U. S. and Canada	Eastern District
Total projects	28,370	3,635
Buildings and industrials	11,425	1,659

Of these 28 per cent are contracts awarded; about 25 per cent bids desired; 7 per cent bids received; 30 per cent proposed.

Bids Wanted on Large Jobs of a Single Week

In last week's issue bids were asked on forty-three building projects averaging $367,000, a total of $15,775,000. The engineer's estimate on every one of these buildings amounted to $150,000 or over.

In addition, bids were asked on a dozen industrial projects aggregating $2,000,000.

Total number of large jobs of all kinds, now out for bids, is as follows:

	Number	Bids Wanted
Water-works	32	Feb. 10 @ Mar. 7
Sewers	12	Feb. 12 @ Mar. 12
Waste disposal	4	Feb. 13 @ Mar. 1
Bridges	14	Feb. 13 @ Sept. 1
Dams	3	Feb. 20 @ Feb. 28
Excavation and Dredging	5	Feb. 13 @ Mar. 1
Streets and roads	44	Feb. 12 @ Apr. 23
Industrial work	4	Feb. 13 @ Feb. 24
Buildings	57	Feb. 12 @ Apr. 1
Federal Gov't. Work	23	Feb. 12 @ May 10
Miscellaneous	21	Feb. 12 @ Feb. 26
Total	155	Feb. 10 @ Sept. 1

In the "Miscellaneous" columns, alone, of the Feb. 1 issue, bids were invited on thirty-two jobs. The various wants amounted to $25,000 worth of tools, 20,000 bags of cement, 50,000 granite blocks, 600 tons asphaltic cement, 2,500,000 gal. of road oil, 35,000 ft. of pipe and culverts, 613,000 ft. of lumber, and 570,000 lb. of reinforcing steel. These items will amount to more than a quarter of million.

Some Unit Bids of the Week

Kansas—2-in. galvanized pipe, 43c. per ft.; 4-in. c.i. pipe, 95c.; 6-in. c.i., $1.30.

North Carolina—Paving 5,000 sq.yd. with sheet asphalt, $2.78 per sq.yd.; with bitulithic, $2.48.

Florida—5,405 lin.ft. concrete gutter, 60c. per lin.ft.; 60,000 sq.ft. concrete sidewalks, 19⅔c.

Michigan—76,612 sq.yd. gravel surface, 80c.

New Jersey—40,000 gal. tar patching material, 19c.

Missouri—6,000 tons roofing gravel. $1.65@$1.80.

Important Foreign Construction Projects Reported

Progress on a number of important public works in foreign countries has been reported to the United States Department of Commerce during the week of Feb. 3, as follows:

China.—Approximate cost estimates have been prepared and suggestions made for financing the international bridge at Tientsin. Nothing definite has yet been decided upon except the site. Either a bascule or rolling lift type is favored, Consul General Stuart J. Fuller, Tientsin, China, reports.

Australia.—Announcement has been made by the Premier of New South Wales, according to a report from Consul R. Wormuth, that the policy of the previous governments in granting a preference to local manufacturers of 10 per cent on tenders for public work will be recognized and followed by him on materials and contracts for the North Shore Bridge across Sydney Harbor.

The Melbourne City Council has purchased an asphalt mixing plant from the Geiger Co. of California, U. S. A., at a cost of 9,500 pounds sterling. This is for road purposes and to overcome the dust problem in the city.

Colombia.—Consul S. H. Piles, Bogota, reports that authorization has been given the government by a law passed December 14, 1922, to contract loans up to $100,000,000 for the construction of railways, port works, and for waterway improvement. Loans under this law must have the sanction of the National Loan Board which has supervision also of the expenditure of the money.

Rumania.—Construction is to begin this spring of a railroad 70 kilometers in length connecting the towns of Ilva-Mare and Vatra Dornei. Other railroad extensions and certain gage-widening work are also planned for 1923, according to a report from Consul Ely E. Palmer, Bucharest.

Finland. — Petitions proposing the construction of new railroads have been considered by the Finnish Committee on Communications. During the next five years 100,000,000 Finnish marks (present value about 2.5c.) will be included in the annual budget, this sum having already been appropriated for 1923, says Consul Leslie A. Davis, Helsingfors.

Siam. — Recommendations for the erection of a garbage incinerator and a series of crematories have been made to the government of Siam by the official health adviser. Plants of the most modern types are being considered, Trade Commissioner John A. Fowler reports.

Brazil.—The C. A. D. Bayley Co. of Atlanta, Ga., have concluded contracts in connection with a loan of $2,000,000 to the State of Cerea, Brazil, covering water and sewerage systems for Fortaleza, its capital.

Canada.—The Canadian National Ry. has awarded to Foley, Welch & Hervey a contract for the construction of the "Longlac cut-off," a 29-mile link from Longlac on the main line between Toronto and Winnipeg to Nakina. The construction of this line will reduce the distance between Toronto and Winnipeg by 103 miles and save several hours running time.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 69 to 81, are the following projects:

Office building, Chicago, Ill., to Starrett Bros., $8,000,000.

Bank and office, Philadelphia, Pa., to Thompson-Starrett Co., New York City, $3,000,000.

High school, New York, N. Y., to J. S. Brady & Co., $2,311,380.

Hotel, Cleveland, O., to Crowell and Little Construction Co., $2,000,000.

Railroad, Kentucky, for Illinois Central R.R., from Central City to Dawson Springs, to A. Guthrie & Co., St. Paul, Minn., $1,500,000.

College, Mountain View, Calif., to J. L. McLaughlin, San Francisco, $1,250,000.

Capitol annex and memorial, Nashville, Tenn., to A. J. Krebs & Co., Atlanta, Ga., $1,240,000.

Heavy Locomotive Orders Placed by Railroads

Aside from gains made in locomotive repairs during December, eleven railroads placed orders with the American Locomotive Co. for 133 engines of various types. During the last week of 1922, new business placed with the Lo-

comotive Company amounted to $6,600,000.

Shipments of locomotives in December, as compiled by the Department of Commerce from reports of principal manufacturers, were the largest since January, 1921, and amounted to 210, as against 89 in December, 1921. Total shipments for the year 1922 reached 1,274, of which 218 were for export; representing a drop of nearly 6 per cent from the preceding year. Unfilled orders on Dec. 21, amounted to 1,592 locomotives, a slight decline from the previous month.

Business Failures Decrease

All sections of the United States showed decreases in the number of failures reported to R. G. Dun & Co. for the week ending Feb. 3, and the total is 437, as against 511 during the preceding week and 629 a year ago.

The number of defaults with liabilities of more than $5,000 in each instance is lower, being 255 as compared with 298 in the previous week, but both numbers represent the same proportion of their respective totals, being 58.3 per cent. In the corresponding week of last year, similar insolvencies aggregated 391, or 62.1 per cent of the total.

Canadian failures number 84, while for the week preceding they were 82 and a year ago 52. Defaults involving more than $5,000 in each case are 36 in number, as against 41 in the previous week and 23 in the corresponding period last year.

Next week—résumé of recent public bond sales, showing rate, yield, price and by whom handled.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of February 1; the next, on March 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	+$3.29	$3.95	$4.40	+$3.05	+$3.30	+$3.95	$3.25	+$3.80	$3.50
Structural rivets, 100 lb.	3.85	4.60	5.25	3.75	4.00	+4.95	4.75	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	+3.19	3.85	3.15	+2.95	+3.20	3.62½	3.30	+3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	+51%	53%	45%	59½%	+55-5%	+38%	39.2@51.8%	45%	22.50
Cast-iron pipe, 6 in. and over, ton.	+57.30	+57.80	+57.00	52.20	+56.20	+65.60	+56.00	+56.00	55.00
Concreting Material:									
Cement without bags, bbl.	2.60@2.70	+2.75	2.25	2.05	2.29	2.85	2.71	2.90	2.15
Gravel, ¾ in., cu.yd.	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd.	1.00	—1.24	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	+2.00	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+61.00	—35.00	50.00	+56.50	42.75	+54.00	—36.00	+29.00	90.00
Lime, finishing, hydrated, ton.	16.80@17.10	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	+3.00@3.25	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000.	23.50	+11.00	11.00	11.00	—17@19	12.00	15.50	13.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0836	.065	....	.11	—.105
Hollow partition tile 4x12x12, per block	.1230	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	+.96	1.03	1.07	+1.02	1.04	+1.13	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	.....	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour.	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.50	....—.25@.30	

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81½c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.82). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $22.50; 6-in., $108.

Changes Since Last Week

Discounts on wrought steel pipe reduced two points on Pittsburgh basing card of Feb. 3, 1923; change reflected in warehouse quotations in New York, Minneapolis, Denver and other important centers. Steel structurals up 15c. in New York and Minneapolis and 10c. per 100 lb. in Denver and Seattle warehouses, following stiffer prices at mill. All new business on steel structurals at $2.10 per 100 lb. f.o.b. mill, or higher. Large tonnage orders on books of leading producers sufficient to keep mills busy for next three or four months. Semi-finished steel also tending higher.

Cast-iron pipe advanced $1 in Minneapolis, Dallas, Denver and Chicago; and $2 per ton in New York, San Francisco and Seattle, during last two weeks. The market for this material is strong and very active, and in view of advancing pig-iron prices, further rises are expected.

Lumber prices are displaying unusual firmness, with price advances in several important cities. During the last two weeks, pine timbers have gone up $2 in New York and $4.50 per M. ft. in Chicago; Douglas fir rose $2.50 in Denver and $4 per M. ft. in Seattle.

Common brick reported $1 per M. higher in Atlanta, with slight decline in Minneapolis. New York price firm at $20 per M., alongside dock. Although no new brick are being received from the Hudson River district, because of ice, there are about eighteen bargeloads of covered brick in winter storage.

The linseed oil market, keeping pace with white and red lead, is advancing generally. New York quotes rise of 3c. per gal., effective Feb. 3. Chicago reports advance of 4c. and Denver 3c. per gal. during week. White and red lead rose ¾c. per lb. in month.